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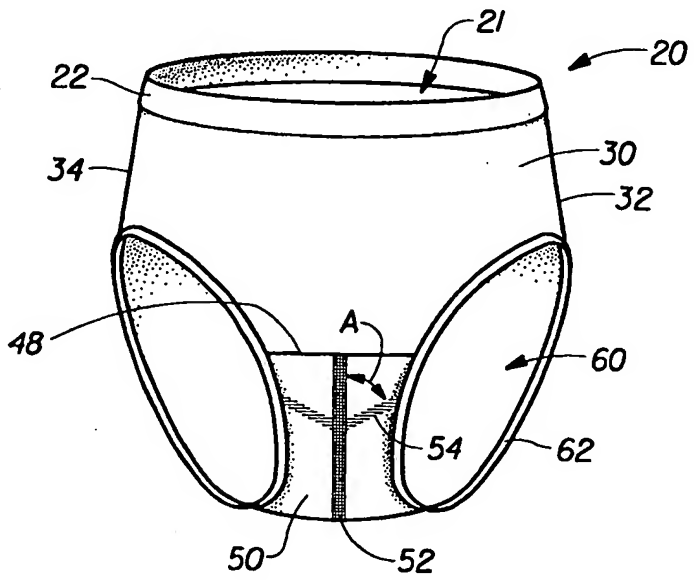
(57) Abstract

A system of a highly efficient absorbent article and a supporting garment, such as an undergarment, for supporting the absorbent article in sustained close contact with a wearer's body is disclosed. The absorbent article is capable of maintaining contact with and covering at least a portion of the inside surfaces of the wearer's labia, at least a portion of the exterior surfaces of the wearer's labia, and at least a portion of the crotch region of the supporting garment. The supporting garment may fit the wearer's body so closely that it resembles a comfortable "second skin". The absorbent article is flexible under the body-contacting forces that are applied by the supporting garment so that it also conforms to the wearer's body.



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SYSTEM OF HIGHLY EFFICIENT ABSORBENT ARTICLE AND UNDERGARMENT FOR SUPPORTING THE SAME

FIELD OF THE INVENTION

The present invention relates to a system of a highly efficient absorbent article and an undergarment for supporting the same in sustained close contact with a wearer's body. The system can be used for menstrual purposes, incontinence protection, or both.

BACKGROUND OF THE INVENTION

As is known, disposable catamenial devices are commercially available in a wide variety of configurations for the specific purpose of absorbing and retaining menstrual fluids and other vaginal discharges. Unfortunately, such catamenial devices may leak menses along their periphery due to poor fit or improper placement. Such leakage frequently results in soiling of a wearer's undergarments, clothing or bedding.

To provide additional protection against leakage, it is known to use a washable and reusable garment, such as a menstrual short or panty, in combination with a disposable catamenial pad. For example, U.S. Patent 3,489,149, issued to Larson on January 13, 1970, discloses a washable menstrual panty having a small pocket in the crotch area for retaining a disposable catamenial pad. Since the menses must initially flow through a layer of material forming the pocket to reach the catamenial pad, removal of the soiled catamenial pad can be distasteful, difficult and unsanitary. While a new pad can be inserted into the pocket, the garment is already soiled and would typically be changed. Also, the pocket may not accommodate the varied sizes of catamenial devices currently on the market. Further, the layer of moisture resistant material described therein fails to provide ventilation or breathability in the crotch region with a resulting potential for wearer discomfort when such a panty is worn.

The art has also attempted to address leakage from a catamenial device by providing absorbent material in a region surrounding the device and means for positioning the catamenial device. For example, U.S. Patent 4,560,381, issued to Southwell on December 24, 1985, describes a mesh-like outer panty shell with a thick inner layer of absorbent

material in the lower crotch area of the panty. The inner layer of absorbent material includes a depression for receiving and positioning a catamenial pad. An alternative embodiment includes a barrier film between the absorbent material and the panty shell. However, if the barrier film is present, the crotch portion will not be breathable (with resulting discomfort) and if the barrier film is absent, there is a risk of leakage.

In U.S. Patent 4,813,950, issued to Branch on March 21, 1989, a washable menstrual panty is disclosed as having an outer lining of spandex, soft tricot, etc. which provides a "skin tight or almost skin tight" fit and an inner lining of a microporous plastic film to prevent passage of menses therethrough while allowing passage of gasses. Similarly, existing Japanese-style menstrual shorts act like a girdle or a very tight fitting panty which attempts to hold a catamenial device in the wearer's pudendal region. However, the tight fit of such undergarments has been reported to be uncomfortable to wearers and there is no apparent provision for directly lifting a catamenial device to a position close to a wearer's pudendal area.

A menstrual short panty having an elastic piece fixed to the front and rear of the crotch region in an elongated state is described in U.S. Patent 3,608,551, issued to Seijo on September 28, 1971. The elastic piece is said to keep a sanitary napkin raised and in contact with "the private parts of a human female's body irrespective of her physical movements...." The elastic piece is joined to the leg openings by an open mesh network and the crotch region underlies the network. While such a device may improve body contact along a coronal centerline of a wearer's body, the device is unlikely to lift a catamenial absorbent into conformity with the external surface of a wearer's labia. Further, the narrow central elastic piece may cause the device to be uncomfortable to wearers because all of the lifting force appears to be concentrated along the wearer's coronal centerline.

Japanese Utility Model 4-9222, published in the name of Kao Corp. on August 11, 1992 describes an undergarment having portions with differing mechanical properties wherein the fabric comprising the front part, the crotch part and the back central part has a longitudinal tensile strength that is at least twice the longitudinal tensile strength of the left and right back parts. With the tensile strength in the lateral direction being less than the tensile strength in the longitudinal direction in each of the parts. The undergarment is said to expand and shrink in accordance with wearer movement so a sanitary napkin disposed thereon will not shift. While such a garment may improve contact between the garment and

a sanitary napkin disposed thereon, such improved contact will not, of necessity, provide improved body contact. Importantly, the consistent nature of the mechanical properties of the fabric that makes up the front part, the crotch part, and the back central part means that the garment is likely to provide an essentially constant force throughout the crotch part.

U.S. Patent 5,611,722, issued to Osborn on March 18, 1997 describes a panty-type undergarment. The panty-type undergarment has a front panel, a rear panel, and a crotch portion. The undergarment further includes a substantially anchor-shaped support panel having a greater resistance to stretch than the rest of the undergarment which is integrally knit into the rear panel. The support panel is said to lift and separate the cheeks of a wearer's buttocks. The support panel includes a vertical strip and upwardly curving portions which extend toward and along a portion of the undergarment's leg openings. While such undergarments may lift and separate the cheeks of a wearer's buttocks, the undergarments fail to provide a lifting force that would improve bodily contact between a catamenial device and a wearer's pudendal region.

Disposable menstrual panties are also known. For example PCT Application WO 95/06451 published in the name of Kimberly-Clark Corporation on March 9, 1995 describes a disposable menstrual panty said to provide backup leakage protection by way of an absorbent/barrier composite positioned in the crotch area of the panty. The menstrual panty described therein is also provided with circumferentially oriented elastics said to allow the panty to conform to various body types and builds. However, because they only encircle a wearer's waist and hip areas, such elastics provide no "z direction" (i.e. upward) biasing force to help maintain a catamenial device in contact with a wearer's pudendal region. As a result, there is a risk of leakage around the catamenial device and a resultant risk of soiled outer garments or bedding.

It is therefore an object of the present invention to provide an undergarment that conforms to the external surfaces or a wearer's pudendal region without causing substantial discomfort. It is another object of the present invention to provide an undergarment that fits against a wearer's body so closely that it is like a "second skin". It is a further object of the present invention to provide an improved undergarment for use with a catamenial device or an incontinence control device which causes such devices to conform to the external surfaces of a wearer's pudendal region so as to provide improved protection against leakage. It is still a further object of the present invention to provide an undergarment which provides a biasing force to help insure close contact between such devices and a

wearer's pudendal region throughout the full range of wearer motions without causing any significant wearer discomfort.

These and various other objectives of the present invention will be more readily apparent when considered in reference to the following description and when taken in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention relates to a system of a highly efficient absorbent article and an undergarment for supporting the absorbent article in sustained close contact with a wearer's body. The system can be used for menstrual purposes, incontinence protection, or both.

The system preferably comprises:

a disposable absorbent article comprising a liquid pervious side, a liquid impervious side opposite the liquid pervious side, and an absorbent component between the liquid pervious side and the liquid impervious side, wherein the liquid pervious side and the liquid impervious side are arranged to form a unitary structure, and the disposable absorbent article is capable of maintaining contact with and covering at least a portion of the inside surfaces of the wearer's labia, and at least a portion of the exterior surfaces of the wearer's labia; and

a garment for wearing around a wearer's waist for holding the disposable absorbent article in close bodily contact, the garment having a waist opening, a pair of leg openings, and a longitudinal centerline, the garment comprising a crotch region that is capable of holding the disposable absorbent article in close contact with the wearer's pudendal region, wherein the disposable absorbent article is capable of covering at least a portion of the crotch region of the garment.

In some preferred embodiments of the system, the disposable absorbent article is of a size and configuration to only cover a female wearer's pudendal region and perineum and immediately adjacent regions, and does not extend substantially forward beyond the wearer's mons pubis or rearward to the wearer's anus.

The garment preferably maintains the disposable absorbent article in substantially sustained contact with the wearer's body so that the absorbent article covers at least a

portion of the inside surfaces of the wearer's labia, at least a portion of the exterior surfaces of the wearer's labia, and at least a portion of the crotch region of the garment in use. Preferably, the disposable absorbent article covers substantially all of the interior surfaces of the wearer's labia up to and including the floor of the wearer's vestibule. The disposable absorbent article may also cover substantially all of the exterior surfaces of the wearer's labia.

The crotch region of the garment can assume a configuration that generally conforms to the shape of the wearer's pudendal region in use. Preferably, the garment does this regardless of whether the wearer's legs are together or apart. In some preferred embodiments, the crotch region of the garment assumes a modified cusp-shaped configuration when worn, wherein the cusp-shaped configuration is modified in that the crotch region assumes a rounded convex upward shape in the longitudinally-oriented area centered about the space between the wearer's labia which lies between two convex downward curved portions of the crotch region. The disposable absorbent article is preferably sufficiently flexible in at least several regions thereof so that the disposable absorbent article assumes a configuration similar to the crotch region of the garment.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following description which is taken in conjunction with the accompanying examples and drawings in which:

Figure 1 is a front view of a preferred embodiment of the menstrual undergarment for use in the system of the present invention.

Figure 2 is a rear view of the menstrual undergarment shown in Figure 1.

Figure 3 is a schematic partial coronal cross section showing the crotch region of a prior art conventional undergarment during wear with the wearer's legs apart.

Figure 4 is a schematic partial coronal cross section showing the crotch region of a prior art conventional undergarment during wear with the wearer's legs together.

Figure 5 is a schematic partial coronal cross section showing the crotch region of the undergarment for use in the system of the present invention during wear with the wearer's legs apart.

Figure 6 is a schematic partial coronal cross section showing the crotch region of the undergarment for use in the system of the present invention during wear with the wearer's legs together.

Figure 7 is a frontal photograph of an undergarment for use in the system of the present invention with the wearer's legs closed.

Figure 8 is a frontal photograph of an undergarment for use in the system of the present invention with the wearer's legs open.

Figure 9 is a frontal photograph of a conventional knit undergarment of the prior art with the wearer's legs closed.

Figure 10 is a frontal photograph of a conventional knit undergarment of the prior art with the wearer's legs open.

Figure 11 is a plan view of the menstrual undergarment shown in Figure 1 that has been opened at the side seams, the elastic components being pulled flat.

Figure 12 is a plan view of an absorbent article suitable for use with the present invention.

Figure 13 is a perspective view of the Lift Test apparatus.

Figure 14 is a front view of the Pin Chamber caliper measurement device used in the Lift Test.

Figure 15 is a bottom view of the Lift Test apparatus.

Figure 16 is a side view of the Lift Test apparatus.

Figure 17 is a cross-sectional view of one of the PLEXIGLAS plates used in the Lift Test apparatus as taken along line 17–17 of Figure 16.

Figure 18 is a side view of the calibration of the Lift Test apparatus showing a properly disposed undergarment.

Figure 19A is a photographic image of a rear view of the instrumented mannequin used in the body contact force test method.

Figure 19B is a schematic diagram of a rear view of the instrumented mannequin showing the placement of the force sensors. properly disposed undergarment.

Figure 20A is a photographic image of a front view of the instrumented mannequin used in the body contact force test method.

Figure 20B is a schematic diagram of a front view of the instrumented mannequin showing the placement of the force sensors.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a system of a highly efficient absorbent article and an undergarment for supporting the absorbent article in sustained close contact with a wearer's body. The system can be used for menstrual purposes, incontinence protection, or both.

A particularly preferred form of supporting garment or undergarment for use in the system of the present invention is intended for use with catamenial devices, such as sanitary napkins, panty liners, and the like, to hold such devices in close body contact to help reduce the leakage from such devices. It should be understood, however, that the present invention is also applicable for use not only with catamenial devices but also other absorbent articles such as incontinence devices, particularly devices intended for wearers suffering from urinary incontinence, diaper inserts, and the like.

As used herein, the term "catamenial device" refers to an absorbent article which is worn by females adjacent to the pudendal region for absorbing and containing bodily fluids, such as menstrual fluids and other vaginal discharges. As used herein, the term "pudendal" refers to the externally visible female genitalia and is limited to the labia majora, the labia minora, the clitoris and the vaginal vestibule. In addition, the term "perineum" refers to the external region of the female's body between the anus and the pudendal region while the term "gluteal groove" refers to the crevice between the buttocks (gluteus maximi) extending upwardly from the perineum. As used herein, the terms "fluid", "liquid" and the like are intended to be interchangeable and refer to materials that are in a liquid state when they are at a temperature of about 100°F.

General Description of the Undergarment

While, as noted above, the present invention is suitable for use with a wide variety of absorbent articles, it will be described in terms of a menstrual undergarment 20 which may

be used in conjunction with an absorbent article, such as catamenial device 200. Figures 1 and 2 show front and rear views of the menstrual undergarment 20 for use in the system of the present invention. As is shown in Figures 1 and 2, the menstrual undergarment 20 for use in the system of the present invention comprises a front region, such as front panel 30; a rear region, such as rear panel 40; a crotch region, such as, crotch panel 50; a pair of elasticized leg openings 60, and an elasticized waistband 22. The front panel 30 and the rear panel 40 are extensible in at least the longitudinal direction. The crotch panel 50 is extensible in at least the lateral direction. As used herein, a material is "extensible" if, when an external force is applied thereto, the material lengthens in the direction of the applied force and which will recover, upon release of the applied force, at least about 10 percent of its elongation.

The menstrual undergarment 20 is also provided with a waist opening 21 allowing entry into the menstrual undergarment 20. The menstrual undergarment 20 further comprises a lifting member 42 disposed along the longitudinal centerline L in the rear panel 40, a longitudinal stretch control member 52 disposed along the longitudinal centerline in the crotch panel 50, and, preferably, a plurality of angled stretch control members 54 disposed at an angle A with respect to the longitudinal stretch control member 52 and extending therefrom to the leg elastics 62. It should be noted that the front edge 48 of the crotch panel 50 is preferably situated so that it lies under or behind (i. e. rearward of) a wearer's pubic bone so that the pubic bone does not interfere with the fit of the menstrual undergarment 20. Each of these elements will be described in greater detail in the following sections.

As noted above, one of the objects for use in the system of the present invention is to provide an undergarment that fits against a wearer's body, particularly the pudendal area thereof, so closely that it is like a "second skin". Figures 3 to 6 schematically compare the fit of a conventional prior art undergarment in the crotch region when the wearer's legs are apart, and when they are brought together with the fit of the menstrual undergarment 20 for use in the system of the present invention. A similar comparison is shown photographically in Figures 7–10.

As shown in Figures 3 and 9, the crotch region of such a conventional undergarment sags when the wearer's legs are brought together. As shown in Figure 4, when the wearer's legs move apart, the crotch region of the conventional undergarment "gaps" or spans a longitudinally oriented area centered about the space between the wearer's labia. While

Figure 10 does not clearly show such gapping, the lack of close body contact when the wearer's legs are spread is obvious.

On the other hand, the menstrual undergarment 20 for use in the system of the present invention, as shown in Figures 5, 6, 7, and 8, comfortably fits against and conforms to the outside surfaces of the labia majora whether the wearer's legs are apart, or together. As shown in Figures 5 and 6, in schematic partial coronal cross-section, the menstrual undergarment for use in the system of the present invention maintains a modified cusp-shaped configuration in this area throughout a range of body motions. The cross-sectional configuration of the menstrual undergarment is described as being a "modified" cusp-shape because it may, but preferably does not form a point where the curved portions meet in the longitudinally oriented area at the space between the wearer's labia, but is more rounded, and preferably convex in this area. Similarly, Figures 7 and 8 demonstrate this modified cusp configuration in that the longitudinal stretch control member clearly remains disposed between the distal ends of the wearer's labia whether her legs are close together or spread (i.e. there is some penetration into the labial cleft).

Figure 11 shows the menstrual undergarment 20 for use in the system of the present invention in a full flat out position wherein each of the side seams 32, 34 has been opened and elastic components have been pulled flat. Figure 11 can also be considered to be a plan view of a blank for the menstrual undergarment 20 (see Forming the Undergarment below). As can be seen from Figure 11, the menstrual undergarment 20 has a longitudinal centerline L and a transverse centerline T. As is also shown clearly in Figure 11, the menstrual undergarment 20 for use in the system of the present invention is symmetric about the longitudinal axis L and asymmetric about the transverse axis T. While not being bound by theory, it is believed that this transverse asymmetry enables the leg elastics 62 to provide a force which causes the crotch panel 50 curve upwardly over the external surface of a wearer's labia when the menstrual undergarment 20 is worn. It is further understood that co-operation between the leg elastics 62 and the angled stretch control members 54 provides the crotch panel 50 with resistance to narrowing on application of a longitudinally directed force resulting in a reduction in relative motion between the crotch panel 50 and a wearer's labia caused by wearer movement.

The menstrual undergarment 20 can comprise woven, nonwoven or knit fabrics. Preferably the menstrual undergarment 20 comprises a knit fabric. A particularly preferred knitting means involves first knitting a seamless tubular blank approximately half the final

width of the menstrual undergarment 20. The tubular blank may be knit to have an hour glass shape so as to provide for the leg openings 60 in the finished menstrual undergarment 20 or, alternatively, portions of the opened tube may be cut away to provide for such leg openings 60 (see Forming the Undergarment below).

The Elasticized Waistband

As noted above, the waist opening 21 allows entry into the undergarment 20 for use in the system of the present invention. Preferably the waist opening 21 is provided with an elasticized waistband 22 such that the waist opening 21 conforms closely to a wearer's waist. The elasticized waistband 22 may be formed by providing an elastic member, such as a Lycra® or SPANDEX material, adjacent each distal end of the blank that is shown in Figure 11, C-folding each distal end about itself to form end edges 23 and 24, and seaming the side edges 25–28 of the front panel 30 and the rear panel 40 to form the waist opening 21 and the elasticized waistband 22. Preferably, the elasticized waistband 22 comprises the same yarns as and is integrally knit with the front panel 30 and the rear panel 40. More preferably, the elasticized waistband 22 comprises a turned welt as is known to the art. A particularly preferred knitting pattern for the elasticized waistband 22 comprises a combination of plain knit stitches and float stitches wherein every fourth wale is provided with a positive float stitch.

The Front Region

As can be seen in Figures 1 and 2, the front region, as exemplified by front panel 30, is that portion of the menstrual undergarment 20 that co-operates with the rear panel 40 (discussed below) to encircle a wearer's waist and hips. As can be also seen in Figures 1 and 2, the front panel 30, the rear panel 40, and the crotch panel 50 also co-operate to define the leg openings 60 (discussed in detail below). The front panel 30 is also preferably extensible in at least the longitudinal direction, preferably both the longitudinal and transverse directions, so that it is able to readily conform to a wide range of bodily shapes.

While alternate structures can be used, for example, the front panel 30 could be cut to an appropriate shape from a woven or nonwoven material and joined to the remaining portions of the menstrual undergarment 20, the front panel 30 for use in the system of the present invention is preferably wholly plain knit, more preferably jersey knit, from a combination of elastically extensible and non-elastically extensible yarns. As is clear to one of ordinary skill in the art, the elastic properties of the individual yarns and the particular

knitting pattern can be used by a designer to define the mechanical properties of the front panel 30. In a particularly preferred embodiment for use in the system of the present invention, the front panel 30 comprises alternating courses of wholly plain knit, preferably jersey knit, nylon and Lycra® or SPANDEX yarns as are available from Unifi, Inc. of Greensboro, NC. In an alternative embodiment, the front panel 30 can be wholly plain knit, preferably jersey knit, using a Lycra® or SPANDEX yarn having suitable mechanical properties in all courses. As will be clear from the discussion of the mechanical properties of the front panel 30 below, one of skill in the art could define other knitting patterns using alternative yarns to provide such mechanical properties. As noted above, front panels 30 comprising woven or nonwoven materials having such mechanical properties as are described below are also envisioned.

In the preferred embodiment for use in the system of the present invention shown in Figures 1, 2, and 11, the front panel 30 is extensible in at least the longitudinal direction. Preferably, the front panel 30 is elastically extensible in both the longitudinal and transverse directions. Such elastic extensibility enables the menstrual undergarment 20 for use in the system of the present invention to fit a variety of bodily shapes and sizes and provides good conformity to a wearer's body. An extensible front panel 30 further co-operates with the rear panel 40 and the crotch panel 50 to provide a "z-direction" biasing force to the crotch panel 50 throughout a wide range of wearer movements. Such a biasing force helps maintain a catamenial device 200 (Figure 12) as may be worn with the menstrual undergarment 20 in close bodily contact, particularly with a wearer's pudendal region. More preferably, the biasing force directs an absorbent article, such as catamenial device 200, such that the article is held closely against a wearer's body, wherein the front edge 202 of such a device lies in a position slightly anterior to the introitus and the rear edge 204 thereof lies posterior to the perineum. Still more preferably, such a biasing force maintains the device 200 in such a position throughout a wide range of wearer motions. This biasing force will be discussed below in greater detail in the Longitudinal Stretch Control Member section below. Preferably, the front panel 30 is constructed so as to have a longitudinal stretch modulus of between about 1 gram/inch (0.4 grams/centimeter) and about 50.0 grams/inch (19.7 grams/centimeter). More preferably the longitudinal stretch modulus is between about 3 grams/inch (1.2 grams/centimeter) and about 40 grams/inch (15.7 grams/centimeter). Particularly preferably, the longitudinal stretch modulus of the material comprising the front panel 30 is quite low (particularly in comparison to other undergarments of the art) and lies between about 3 grams/inch (1.2 grams/centimeter) and

about 20 grams/inch (7.9 grams/centimeter). A suitable method for measuring stretch modulus is described in the TEST METHODS section below.

The Rear Region

As noted above, the rear region, as exemplified by rear panel 40, cooperates with the front panel 30 to encircle a wearer's waist and hips. As is shown most clearly in Figure 11, the rear panel 40 comprises first and second sections 44, 46. The sections 44, 46, which are separated by the longitudinally extending, extensible lifting member 42 (discussed as a separate element below), provide coverage to a wearer's buttocks and have disposed thereon a portion of the elasticized waistband 22 which encircles a wearer's waist. The rear panel 40 is also preferably elastically extensible in at least the longitudinal direction, preferably both the longitudinal and transverse directions, so that it is able to readily conform to a wide range of bodily shapes.

In a manner similar to the front panel 30, the first and second sections 44, 46 of the rear panel 40 are preferably wholly plain knit, more preferably jersey knit, from a combination of elastically extensible and non-elastically extensible yarns. Again, other materials, such as the cut and sewn woven or nonwoven materials discussed above, which also have the requisite mechanical properties, are also suitable. As is clear to one of ordinary skill in the art, the elastic properties of the individual yarns and the particular knitting pattern can be used by a designer to define suitable mechanical properties. In a particularly preferred embodiment for use in the system of the present invention, the first and second sections 44, 46 of the rear panel 40 comprise alternating courses of wholly plain knit, preferably jersey knit, nylon and Lycra® or SPANDEX yarns as are available from Unifi, Inc. of Greensboro, NC. In an alternative embodiment, the front panel 30 can be wholly plain knit, preferably jersey knit, using a Lycra® or SPANDEX yarn having suitable mechanical properties in all courses. As will be clear from the discussion of the mechanical properties of the first and second sections 44, 46 of the rear panel 40 below, one of skill in the art could define other knitting patterns using alternative yarns to provide such mechanical properties.

In the preferred embodiment for use in the system of the present invention shown in Figures 1, 2, and 11, the first and second sections 44, 46 of the rear panel 40 are extensible in at least the longitudinal direction. Preferably, the sections 44, 46 are elastically extensible in both the longitudinal and transverse directions. Such elastic extensibility enables the menstrual undergarment 20 for use in the system of the present invention to fit

a variety of bodily shapes and sizes and provides good conformity to a wearer's body. An extensible rear panel 40 further co-operates with the front panel 30, the lifting member 42, and the crotch panel 50 to provide a "z-direction" biasing force to the crotch panel 50 throughout a wide range of wearer movement. Such a biasing force helps maintain a catamenial device 200 (Figure 12) as may be worn with the menstrual undergarment 20 in close bodily contact, particularly with a wearer's pudendal region. More preferably, such a biasing force directs the catamenial device 200 to a relationship with a wearer's body wherein the front edge 202 of such a device lies in a position slightly anterior to the introitus and the rear edge 204 thereof lies posterior to the perineum. Still more preferably, such a biasing force maintains the device 200 in such a position throughout a wide range of wearer motions. This biasing force will be discussed below in greater detail in the Longitudinal Stretch Control Member section below. Preferably, the rear panel 40 is constructed so as to have a longitudinal stretch modulus of between about 1 gram/inch (0.4 grams/centimeter) and about 50.0 grams/inch (19.7 grams/centimeter). More preferably the longitudinal stretch modulus is between about 3 grams/inch (1.2 grams/centimeter) and about 40 grams/inch (15.7 grams/centimeter). Particularly preferably, the longitudinal stretch modulus of the material comprising the first and second sections 44, 46 of the rear panel 40 is quite low (particularly in comparison to other undergarments of the art) and lies between about 3 grams/inch (1.2 grams/centimeter) and about 20 grams/inch (7.9 grams/centimeter). A suitable method for measuring stretch modulus is described in the TEST METHODS section below.

The Lifting member

The lifting member 42 cooperates with the rear panel 40 to provide a "z-direction" biasing force along the longitudinal centerline L of the menstrual undergarment 20 for use in the system of the present invention. This force helps lift the crotch panel 50, particularly the longitudinal stretch control 52 member that is disposed therein, so that the crotch panel 50 and any catamenial device 200 that may be disposed thereon is in close body contact. In particular, without being bound by theory, the lifting member 42 is believed to direct the elastic forces provided by the rear panel 40 along the longitudinal centerline L to help lift the crotch panel 50 into close bodily contact.

As noted above, the lifting member 42 helps provide a "z-direction" biasing force along the longitudinal centerline L. Therefore, the lifting member 42 is preferably disposed along the longitudinal centerline L in the rear panel 40. More preferably, the lifting member

42 divides the rear panel 40 into symmetric first and second sections 44, 46. The lifting member 42 can be joined to the rear panel 40 along the longitudinal centerline L. Preferably, the lifting member 42 is integral to the rear panel 40. In the particularly preferred embodiment shown in Figures 1, 2, and 11, the lifting member 42 is integrally knit with the first and second sections 44, 46 of the rear panel 40.

To facilitate the direction of forces, the lifting member 42 should have less stretch than the first and second sections 44, 46 of the rear panel 40. To provide such lower stretch, the lifting member 42 may comprise a material having a higher stretch modulus than the rear panel 40 or a knit material having a knit pattern as is known in the art to provide greater stretch resistance. Higher stretch modulus materials suitable for use as a lifting member 42 include high modulus film materials, such as a polyester film material or even a single strand of yarn or monofilament having a relatively high modulus (e. g. cotton, polyester or nylon). Preferably, the lifting member 42 comprises the same yarns as are suitable for the first and second sections 44, 46 of the rear panel 40 and is integrally knit therewith using a knit pattern having less stretch than the first and second sections 44, 46. That is, the yarns discussed above with respect to the first and second sections 44, 46 of the rear panel 40 are also suitable for the lifting member 42. A particularly preferred knitting pattern for the lifting member 42 uses stitches known in the art to provide reduced stretch. For example, a pattern of tuck stitches, float stitches, or a combination of tuck and float stitches has been found to be suitable.

As noted above, the Applicants believe that the lifting member 42 helps direct lifting forces provided by the rear panel 40 along the longitudinal centerline L because the lifting member 42 has a higher stretch modulus than the rear panel 40. In particular, the lifting member 42 preferably has a longitudinal stretch modulus of between about 50 grams/inch (19.7 grams/centimeter) and about 110.0 grams/inch (43.3 grams/centimeter). More preferably, the longitudinal stretch modulus is between about 60 grams/inch (23.6 grams/centimeter) and about 100 grams/inch (39.4 grams/centimeter). A suitable method for measuring stretch modulus is described in the TEST METHODS section below.

In an alternative embodiment of the lifting member (not shown) the lifting member comprises two opposed portions each of which extends upwardly and laterally outwardly at an acute angle to the longitudinal centerline on opposite sides thereof. The portions meet in an area of juncture at the rear end of the longitudinal stretch control member. Preferably, the portions comprising this alternative embodiment mirror each other on opposite sides of

the longitudinal centerline. One of skill in the art will recognize that such a structure divides the rear panel 40 into three portions.

By extending upward and outward at an acute angle from the rear end of the longitudinal stretch control member 52 the portions of this alternative embodiment direct those forces resulting from extension of the rear panel 40 such that they converge on the rear end of the longitudinal stretch control member providing a "z direction" biasing force thereto. Preferably, the acute angle is between about 15 degrees and about 45 degrees. More preferably, the acute angle is about 35 degrees.

The Crotch Region

The crotch region, as exemplified by crotch panel 50, is positioned along the longitudinal centerline L of the menstrual undergarment 20 for use in the system of the present invention between the front panel 30 and the rear panel 40. In the preferred embodiment for use in the system of the present invention shown in Figure 11, the crotch panel 50 comprises several portions that are divided by the longitudinal stretch control member 52 and the angled stretch control members 54. In the preferred embodiment for use in the system of the present invention shown in Figures 1, 2, and 11, the crotch panel 50 cooperates with the front panel 30 and the rear panel 40 to define the leg openings 60. The crotch panel 50 is that portion of the menstrual undergarment 20 that has most direct contact with a wearer's pudendal area. The crotch panel 50 also supports any catamenial device 200 that may be worn with such an undergarment 20.

The crotch panel 50 for use in the system of the present invention is particularly able to conform to a wearer's pudendal region. Without being bound by theory, it is believed that the conformity of the crotch panel 50 for use in the system of the present invention is due to the low lateral stretch modulus of the materials used therefor. In particular, as noted above, the lifting member 42 cooperates with the rear panel 40 to provide a "z direction" biasing force along the longitudinal centerline of the undergarment 20 (i. e. along the longitudinal stretch control member 52). The Applicants believe there is a similar "z directed" component to the force provided by the leg elastics 62 that causes the leg elastics to be lifted into the crease between a wearer's pudendal area and her legs. As is shown most clearly in Figure 11, the crotch panel 50 bridges the distance between the longitudinal stretch control member 52 and the leg elastics 62 (i. e. the distal edge 56 of the crotch panel is adjacent to the leg elastics). Because the crotch panel 50 has a low lateral stretch modulus and because it is provided with a "z direction" force at two laterally spaced apart

locations, the Applicants believe that the crotch panel 50 is lifted by the longitudinal stretch control member and the leg elastics and stretched thereby so as to readily conform to external surfaces of those portions of a wearer's pudendal area which lie between the labial cleft and the leg crease.

This conformity is maintained over a wide range of movement. The conformity is shown particularly clearly in Figures 7 and 8 from Example 1 which photographically show that the close body contact of the crotch panel 50 for use in the system of the present invention is maintained when a wearer's legs are close together and when they are spread apart. In contrast, the conventional prior art undergarment, as is shown in Figures 9 and 10, sags below the wearer's pudendal area (i. e. there is no close contact between the crotch of the prior art undergarment and the wearer's pudendal area).

As noted above, it is important that the lateral stretch modulus of the crotch panel 50 be low so as to enable conformity thereof to a wearer's pudendal area. Crotch panels 50 having a lateral stretch modulus of between about 1 gram/ inch (0.4 grams/centimeter) and about 50 grams/ inch (19.7 grams/centimeter) have been found to be suitable for the present invention. Preferably, the crotch panel 50 has a lateral stretch modulus of between about 5 grams/ inch (2.0 grams/centimeter) and about 40 grams/ inch (15.7 grams/centimeter), more preferably between about 10 grams/ inch (3.9 grams/centimeter) and about 30 grams/ inch (11.8 grams/centimeter).

The crotch panel 50 can comprise any woven material, nonwoven material, knit material, or the like that possesses the requisite physical properties as described below. Preferably the crotch panel 50 comprises a knit material having a higher longitudinal stretch modulus than the front panel 30, the rear panel 40 or the lifting member 42. More preferably, as is shown in Figures 1, 2, and 11, the crotch panel 50 is integrally knit with the front panel 30 and the rear panel 40 using a plain knit pattern and yarns having a low extensibility to provide stretch resistance. Additional stretch resistance is provided by the longitudinal stretch control member 52 and the angled stretch control members 54 which are discussed below. The crotch panel 50 also has a lower stretch resistance than the gusset areas of stiff undergarments of the prior art that fail to conform to a wearer's pudendal area.

Suitable yarns for the crotch panel 50 have a relatively high stretch modulus (i. e. yarns that would not be considered elastically extensible by the art). Suitable yarns include natural yarns, such as cotton yarns and wool yarns, and synthetic yarns, such as nylon yarns, polyester yarns, acrylic yarns, and other synthetic yarns having the requisite

mechanical properties. Particularly preferred yarns include nylon yarns and cotton yarns. Alternatively, if an elastically extensible crotch panel 50 is desired, Lycra® or SPANDEX yarns having a greater stretch modulus than the similar Lycra® or SPANDEX yarns used for the front panel 30 and the rear panel 40 can be used.

Longitudinal Stretch Control Member

As noted above the longitudinal stretch control member 52 serves to limit the stretch of the crotch panel 50. In particular, the longitudinal stretch control member 52 limits the longitudinally oriented stretch of the crotch panel 50. Preferably, the longitudinal stretch control member 52 has a greater resistance to stretching than the front panel 30, the rear panel 40 or the lifting member 42 and less resistance to stretching than undergarments of the prior art that fail to conform to a wearer's pudendal area. Consequently, the longitudinal stretch control member 52 has a higher longitudinal stretch modulus than either of the aforementioned front or rear panels and a lower stretch resistance than certain stiff gussets of the prior art. In particular, the longitudinal stretch control member 52 has a longitudinal stretch modulus of between about 50 grams/ inch (19.7 grams/centimeter) and about 500 grams/ inch (196.8 grams/centimeter). Such modulus being measured using samples taken along the longitudinal centerline L of the undergarment 20 (i. e. a portion of the crotch panel 50 may also contribute to the measured modulus). More preferably, the stretch modulus is between about 50 grams/ inch (19.7 grams/centimeter) and about 300 grams/ inch (118.1 grams/centimeter). Particularly preferred crotch panels 50 for use in the system of the present invention have a longitudinal stretch modulus, as measured along the longitudinal centerline thereof, of between about 100 grams/ inch (39.4 grams/centimeter) and about 200 grams/ inch (78.7 grams/centimeter).

While not being bound by theory, such longitudinal stretch limitation is believed to transfer forces from the rear panel 40 (particularly the lifting member 42 therein) and from the front panel 30 to the crotch panel 50 to provide a "z-direction" biasing force thereto. Such force transfer causes the crotch panel 50 and any catamenial device 200 disposed thereon to be held closely against a wearer's pudendal area (particularly along the longitudinal centerline L of the menstrual undergarment 20) throughout a wide range of wearer movements. More precisely, the crotch panel 50 and catamenial devices 200 disposed thereon have been found to be at least partially disposed between the distal ends of a wearer's labia when a menstrual undergarment 20 for use in the system of the present invention is worn.

It is particularly important to note that the "z-direction" biasing force is higher along the longitudinal centerline L (Figure 11) of the undergarment 20 for use in the system of the present invention. That is, the first body contact force, as is provided by the longitudinal stretch control member 42, is greater than the forces provided by other portions of the crotch panel 50 that lie laterally outboard of the longitudinal stretch control member 42. Such increased force is believed to be particularly effective in lifting any absorbent article that may be disposed on the crotch panel 50 into a close relationship with a wearer's vaginal introitus and urethra so as to allow ready interception of bodily fluids that may be exuded therefrom.

While it is important that the "z-direction" biasing force is higher along the longitudinal centerline, there should be an upwardly directed second body contact force over substantially the entire external surface of a wearer's labia. Such lower second body contact force causes any absorbent article disposed on the crotch panel 50 to also conform to the labial surface which provides a "seal" against the distal edges of a wearer's labia majora further reducing the risk of bodily fluids flowing along the surface of the absorbent article to an edge thereof with resulting leakage. On the other hand, a loose prior art garment, such as that shown in Figures 3, 4, 9, and 10, provides no such seal.

Body contact forces, such as the "z-direction" biasing force discussed above and the forces causing the garment for use in the system of the present invention to contact the external surface of a wearer's labia may be estimated using the body contact force test method described in the TEST METHODS section below. As will be noted, this test method uses pressure sensors so such forces are reported as a pressure (i.e. g/cm^2).

The combination of a higher first force along the longitudinal centerline L, a distributed second force over the external labial surface, and a third force contribution by the leg elastics 62 (discussed below) causes an absorbent article disposed on the crotch panel 50 to assume the "modified" cusp configuration shown in Figures 5–8. Such a configuration allows both interception of bodily fluids close to the point of exit from the body and the additional leakage protection of a "seal" against a wearer's labia. In order to achieve this "modified" cusp configuration, the ratio of body contact force along the centerline to the body contact force at the distal edge of the labia majora should be greater than 1:1 when such forces are measured according to the method given in the TEST METHODS section. Preferably the ratio of centerline force to distal edge force is greater than about 1.25:1, more preferably, the ratio is greater than about 1.5:1.

Obviously the actual force values are also important. If the force is too low, the garment will not maintain an absorbent article in close body contact throughout a wide range of wearer motions. If the force is too high, discomfort can result. Suitably, the force along the longitudinal centerline is greater than about 2 g/cm^2. Preferably the first body contact force (i. e. along the longitudinal centerline) is greater than about 2.1 g/cm^2, more preferably greater than about 2.2 g/cm^2. Suitably, the force is less than about 20 g/cm^2, preferably less than about 15 g/cm^2, more preferably, less than about 10 g/cm^2. Similarly, the second force as measured at the apex of the labia majora is suitably greater than about 1 g/cm^2, preferably greater than about 1.1 g/cm^2, more preferably greater than about 1.2 g/cm^2 and less than about 20 g/cm^2, preferably less than about 15 g/cm^2, more preferably less than about 10 g/cm^2.

This force transfer and the resulting close body contact can be further demonstrated by comparing Lift according to the method described in the Test Methods section below (This method is a modification of the method described in U.S. Patent application Serial No. 08/383,536, filed in the name of Osborn III, et al. on February 1, 1995, the disclosure of which is incorporated herein by reference) for the menstrual undergarment 20 for use in the system of the present invention and for undergarments of the prior art. Such measurements are reported in Table 1 below.

Table 1

Comparative Lift Measurements

Lift in Millimeters

(391 grams applied force)

Undergarment Tested	Position 1	Position 2	Position 3
Present Invention	21	30	38
Wonder Body™[1]	14	23.5	33.5
Olga Secret Shapers®[2]	9	19.5	29
Japanese Menstrual Shorts[3]	10.5	15.5	25
Hanes Her Way[4]	4	8.5	23

1) Available from Sara Lee Intimates, Winston-Salem, NC

2) Available from Olga Company, Van Nuys, CA

3) Available from UniCharm of Japan as Sofy Sports

4) Available from Sara Lee Intimates, Winston-Salem, NC

As can be clearly seen in Table 1, the menstrual undergarment 20 for use in the system of the present invention has greater Lift (closer body contact) at all positions of the test apparatus. The difference is most dramatic at Position 1, which, as is described in the aforementioned Osborn, III application, is intended to correspond to the labial area of a wearer's body. Because of the aforementioned higher force along the centerline L, the garment 20 for use in the system of the present invention is able to provide this improved lift and the resulting closer body contact. The menstrual undergarment 20 for use in the system of the present invention preferably has a Lift at Position 1 in the Lift Test apparatus of greater than about 16 mm, a Lift at Position 2 of greater than about 25 mm, and a Lift in Position 3 greater than about 35 mm. More preferably the Lift in Position 1 is greater than about 18 mm, the lift in Position 2 is greater than about 27 millimeters, and the Lift in Position 3 is greater than about 36 mm.

The undergarment 20 for use in the system of the present invention is particularly comfortable to wear (particularly in the pudendal area), notwithstanding the close conformity of the present undergarment to and contact with a wearer's body. Undergarments of the prior have attempted to achieve conformity to the pudendal area by elasticized lifting members, such as cinches, or by a very tight fit overall, such as is seen with Japanese menstrual shorts. Undergarments of either type are often described as uncomfortable. One source of such discomfort, particularly for cinch-type undergarments, is pressure on a wearer's anus. The tissue surrounding the anus is particularly sensitive to pressure and forces applied to the anus can cause discomfort. Cinch-type undergarments, such as that described in the aforementioned U.S. Patent 3,608,551, typically use an

elastically extensible member to provide a lifting force to seal an absorbent article against a wearer's perineum. Such elastic members are usually joined to the undergarment at a location that is positioned above a wearer's anus when the undergarment is worn. As a result, there is not only the desirable lifting force to seal an absorbent article against the wearer's perineum but also an uncomfortable pressure on a wearer's anus. On the other hand, the undergarment 20 for use in the system of the present invention distributes the "z-direction" biasing force discussed above so that bodily contact is maintained throughout a wide range of wearer motions without unacceptable pressure on a wearer's anus. Without being bound by theory, it is believed that the forces distributed along the longitudinal centerline L of the present undergarment 20 are isolated at a point posterior to the anus and on the perineum so that the anus is at least partially bridged by the longitudinal stretch control member 52 with a resulting reduction in force on the anus.

As shown most clearly in Figure 11, the longitudinal stretch control member 52 is disposed along the longitudinal centerline L in the crotch panel 50. The longitudinal stretch control member 52 can be either a separate element joined to the crotch panel 50 or it can be integral to the crotch panel 50. Preferably, the longitudinal stretch control member 52 is integral to the crotch panel 50. In a particularly preferred embodiment for use in the system of the present invention, the longitudinal stretch control member 52 and the crotch panel 50 are integrally knit.

As noted above, the longitudinal stretch control member 52 serves to limit stretch, particularly longitudinally oriented stretch in the crotch panel 50. To this end, the stretch control member can comprise any material having a greater stretch modulus than the crotch panel 50. For example, the stretch control member could comprise a high modulus film material or even a single strand of yarn or monofilament having a relatively high modulus. For the preferred integrally knit longitudinal stretch control member 52 discussed above, the longitudinal stretch control member could comprise the same yarns used for the crotch panel wherein the yarns comprising the stretch control member 52 were knit in a pattern known to the art as being stretch limiting. For example, the longitudinal stretch control member 52 can comprise a knit pattern wherein alternating courses thereof are tucked. Alternatively, an elastic yarn can be floated in to provide the longitudinal stretch control member 52 with additional stretch resistance as is also known in the art.

Suitable yarns for the longitudinal stretch control member 52 are substantially the same yarns or combinations of yarns as have been found to be suitable for the crotch panel 50.

Angled Stretch Control Members

The angled stretch control members 54 also serve to control the stretch of the crotch panel 50. In particular, the angled stretch control members 54 provide a vector that limits laterally oriented stretch in the crotch panel 50. Because there is also a longitudinally oriented stretch control vector provided by the angled stretch control members 54, the angled stretch control members 54 also cause the crotch panel 50 and any catamenial device 200 disposed thereon to curve upward and around the external surfaces of a wearer's labia. Without being bound by theory, the angled stretch control members 54 are believed to help transfer the forces provided by the leg elastics 62, the front panel 30 and the rear panel 40 to the crotch panel 50 resulting in this curved, cup-like configuration. This force transfer also appears to provide a resistive force that minimizes narrowing of the crotch panel 50 on longitudinal extension of the menstrual undergarment 20 (i.e. Poisson narrowing is minimized). This minimization is believed to help reduce motion of the crotch panel 50 relative to a wearer's body as the wearer moves. In other words, it is best understood that the angled stretch control members 54 help make the crotch panel 50 a "low motion zone" with a resulting reduction in the relative motion between a wearer's body and the crotch panel 50. As a result any absorbent article that may be disposed on the crotch panel 50 (e. g. a catamenial device 200 as shown in Figure 12) is more likely to remain in a constant relation with the wearer's pudendal region.

As shown most clearly in Figure 11, the angled stretch control members 54 are disposed at an angle A relative to the longitudinal centerline L in the crotch panel 50. The angled stretch control members 54 can be either a separate element joined to the crotch panel 50 or they can be integral to the crotch panel 50. Preferably, the angled stretch control members 54 are integral to the crotch panel 50. In a particularly preferred embodiment for use in the system of the present invention, the angled stretch control members 54 and the crotch panel 50 are integrally knit.

Angle A is believed to help control the degree of upward curvature provided by the force transfer discussed above. If the angle A is too small, there is insufficient transfer of force from the leg elastics 62 so the crotch panel incompletely wraps the sides of a wearer's labia. If the angle A is too large, there is insufficient transfer of force from the front panel

30 and the rear panel 40 so there is reduced contact at the mons and the perineum. Preferably the angle A is between about 30 degrees and about 75 degrees. More preferably, the angle A is between about 45 degrees and about 75 degrees. In a particularly preferred embodiment for use in the system of the present invention, the angle A is about 60 degrees.

As can also be seen most clearly in Figure 11, the angled stretch control members 54 are preferably longitudinally symmetric. That is, the angled stretch control members 54 are preferably provided in opposed pairs wherein one of each pair extends laterally outwardly at an angle A from the longitudinal stretch control member 52 toward the leg elastics 62. Although other embodiments having differing numbers of such pairs are contemplated, the preferred embodiment for use in the system of the present invention comprises two pairs of angled stretch control members 54 with one pair on each side of the transverse centerline T. A plurality of angled stretch control members 54 is believed to be desirable because such a plurality provides an even distribution of forces such that the crotch panel 50 smoothly wraps the external surfaces of a wearer's labia when a menstrual undergarment 20 for use in the system of the present invention is worn.

Other embodiments for use in the system of the present invention having differing orientations and positions for the angled stretch control members 54 are also contemplated. For example, while the angled stretch control members 54 are shown in Figure 11 as extending forwardly outward (i. e. toward the front panel 30), the angled stretch control members 54 may also extend rearwardly outward (i. e. toward the rear panel 40). The angle A for such embodiments is still an acute angle and has the same ranges as described above. Further, embodiments wherein a portion of the plurality of angled stretch control members 52 extends forwardly outward and a portion of such members extends rearwardly outward are also contemplated. In one example, not shown but similar to the undergarment 20 shown in Figure 11, there are no angled stretch control members 54 positioned in the front portion of the undergarment 20 (i. e. the portion on the side of the transverse centerline T that also contains the front panel 30) but two rearwardly directed angled stretch control members 54 are positioned in the rear portion of the undergarment 20. When evaluated for bodily fit, this embodiment for use in the system of the present invention performed comparably to undergarment 20 described above.

In a manner similar to the longitudinal stretch control member 52, the angled stretch control members 54 serve to limit stretch in the crotch panel 50. In particular, the angled stretch control members serve to limit lateral stretch. Preferably, an angled stretch control

54 has a lateral stretch modulus of between about 50 grams/inch (19.7 grams/centimeter) and about 500 grams/inch (196.8 grams/centimeter). More preferably, the stretch modulus is between about 50 grams/inch (19.7 grams/centimeter) and about 300 grams/inch (118.1 grams/centimeter). Particularly preferred crotch panels 50 for use in the present invention have angled stretch control members 54 with a stretch modulus of between about 100 grams/inch (39.4 grams/centimeter) and about 200 grams/inch (78.7 grams/centimeter).

The angled stretch control members 54 can comprise substantially the same materials as are suitable for the longitudinal stretch control member 52 since both elements tend to limit the stretch of the crotch panel 50. For the preferred integrally knit angled stretch control members 54 discussed above, the angled stretch control members 54 could comprise the same yarns used for the crotch panel wherein the yarns comprising the angled stretch control members 54 are knit in a pattern known to the art as being stretch limiting. For example, the angled stretch control members 54 can comprise a knit pattern wherein alternating courses thereof are tucked. Alternatively, a pattern of float stitches can be used to provide the angled stretch control members 54 with additional stretch resistance as is also known in the art.

Suitable yarns for the angled stretch control members 54 are substantially the same yarns as have been found to be suitable for the crotch panel 50.

Elasticized Leg Openings

As can be seen in Figures 1, 2, and 11, the menstrual undergarment 20 for use in the system of the present invention is also provided with a pair of elasticized leg openings 60. As noted above, the front panel 30, the rear panel 40, and the crotch panel 50 cooperate to define the periphery of each leg opening 60. This periphery is provided with a leg elastic 62 for elasticization of the opening 60. The leg elastics 62 cooperate with the front panel 30, the rear panel 40, and the crotch panel 50 to provide a "z-direction" biasing force to the crotch panel 50 throughout the full range of wearer movement. In particular, the leg elastics provide the distal edge 56 of the crotch panel 50 (i. e. the edge of the crotch panel 50 that helps define the leg opening 60) with a "z-direction" biasing force that lifts the edge 56 causing the crotch panel 50 to conform to the exterior surfaces of a wearer's labia. Said another way, and shown most clearly in Figures 1 and 2, the nature of the leg cut opening 60 also is preferably designed to direct the contractive force of the leg elastics 62 in a more

vertical direction than would be possible if a more circular shape would be used for the leg opening 60

That is, the front panel 30, the rear panel 40, the crotch panel 50, and the leg elastics 62 cooperate to provide a catamenial device 200 that may be disposed on the crotch panel 50 with a uniform upward force against a wearer's body such that the catamenial device is held closely against a wearer's pudendal area throughout a wide range of wearer motions. The leg elastics 62 also preferably cooperate with the angled stretch control members 54 to provide a force vector that causes the crotch panel 50 and any catamenial device 200 that may be disposed thereon to wrap around the external surfaces of a wearer's labia.

While the leg elastics 62 must provide a minimal contractive force around the periphery of the leg opening 60 for proper fit of the undergarment 20, it is important that the contractive force not be so great as to cause discomfort to a wearer. The Applicants have found that a contractive force of at least about 20 grams is necessary to minimize the risk of gapping around the periphery of the leg opening 34. Preferably the contractive force should be at least about 40 grams. More preferably, the contractive force should be at least about 80 grams. Minimizing the stretch modulus over the range of expected elastic extensions during the wear cycle also minimizes the risk of wearer discomfort. That is, if the leg elastics are designed to provide a contractive force of about 80 grams at a typical in use extension, that force should not substantially increase for greater extensions that may either be due to a different wearer leg circumference or due to wearer movement. The Applicants have found that a stretch modulus for the leg elastics between about 540 grams/inch (213 grams/centimeter) and about 590 grams/inch (232 grams/centimeter) provides a good balance between maintaining proper fit and minimizing wearer discomfort. Preferably, the stretch modulus of the leg elastics is between about 550 grams/inch (216 grams/centimeter) and about 580 grams/inch (228 grams/centimeter). Methods for measuring elastic contractions and stretch modulus is given in the TEST METHODS section below.

When such leg elastic materials are used as the leg elastics 62 in the garment 20 for use in the system of the present invention they provide a third body contact force of at least about 5 grams/cm^2 (A body contact force of less than this value has been reported as being too loose by wearers). Preferably the third body contact force is greater than about 7 grams/cm^2. Garments having a third body contact forces on the order of 30 grams/cm^2 have been found to cause a high level of reported discomfort when worn. Therefore suitable

garments 20 have a third body contact force less than this level. Preferably, the third body contact force is less than about 20 grams/cm^2. A particularly preferred garment 20 has a third body contact force between about 5 grams/cm^2 and about 10 grams/cm^2. This third body contact force is measured using a method similar to that described in the TEST METHODS section below. The main difference being that such testing is done by placing a cylinder having a circumference of 60 centimeters in the leg opening 60 to extend the leg elastics 62 rather than on a mannequin. The pressure sensor is placed between the leg elastic and the cylinder to measure the third body contact force.

The leg elastics 62 can be joined to the front panel 30, the rear panel 40, and the crotch panel 50 about the periphery of the leg opening 60 using means known to those of skill in the art. Specifically, the leg elastics 62 are joined to that portion of the side edges 25, 26, 27, 28 which will surround the leg openings 60 (i. e. form the periphery thereof). For example, the leg elastics 62 can be joined to the shell portion 30 and the crotch panel 50 using adhesive means or by mechanical means, such as stitching. For the preferred knit menstrual undergarment 20 for use in the system of the present invention, the leg elastics 62 are preferably joined to the front panel 30, the rear panel 40, and the crotch panel 50 by stitching thereto.

The Absorbent Article

Fig 12 is a plan view of one embodiment of an absorbent article suitable for use in the system of the present invention.

The term "absorbent article", as used herein, refers to articles which absorb and contain body exudates. More specifically, the term refers to articles which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. The term "absorbent article" is intended to include sanitary napkins, pantiliners, and incontinence pads (and other articles worn in the crotch region of a garment).

The term "disposable" refers to articles which are intended to be discarded after a single use and preferably recycled, composted, or otherwise disposed of in an environmentally compatible manner. (That is, they are not intended to be laundered or otherwise restored or reused as an absorbent article.) In the preferred embodiments illustrated in FIG. 12, the absorbent article is a menstrual pad designated 200 that is designed to replace conventional sanitary napkins.

The term "sanitary napkin", as used herein, refers to an article which is worn by females adjacent to the pudendal region that is intended to absorb and contain the various exudates which are discharged from the body (e.g., blood, menses, and urine). Although the absorbent article is shown in the drawings as a menstrual pad that is intended to replace conventional sanitary napkins, it should be understood that the present invention is not limited to a system which uses the particular type or configuration of the absorbent article shown in the drawings.

The absorbent article 200 has two surfaces, a liquid pervious side, body-contacting surface or "body surface" and a liquid impervious side, garment surface. The body surface is intended to be worn adjacent to the wearer's body. The garment surface is intended to be placed adjacent to the supporting garment when the absorbent article 200 is worn.

The absorbent article 200 has two centerlines, a longitudinal centerline and a transverse centerline. The term "longitudinal", as used herein, refers to a line, axis or direction in the plane of the absorbent article 200 that is generally aligned with (e.g., approximately parallel to) a vertical plane which bisects a standing wearer into left and right body halves when the absorbent article 200 is worn. The terms "transverse" or "lateral" used herein, are interchangeable, and refer to a line, axis or direction which lies within the plane of the absorbent article 200 that is generally perpendicular to the longitudinal direction.

The absorbent article has two spaced apart longitudinal edges, two spaced apart transverse or end edges (or "ends"), which together form the periphery of the absorbent article. In the embodiment shown in FIG. 12, the absorbent article 200 has a generally flat configuration. In other embodiments, the absorbent article 20 may have other suitable configurations, including cup-shaped configurations, in which the absorbent article 200 is cupped from front to back and/or side to side.

The absorbent article 200 may also have any suitable plan view configuration. Suitable configurations include, but are not limited to: oval; race-track shaped; shapes which have convexly-inward longitudinal side edges (e.g., hourglass shapes); key-hole shapes which have a wider rounded or oval portion which is preferably worn toward the rear of the wearer's body, preferably for covering at least a portion of the wearer's perineum and a generally rectangular extension therefrom (preferably with rounded edges) which is preferably worn toward the front of the wearer's body for covering at least a portion of the wearer's pudendal region. In the embodiment shown in FIG. 12, the

absorbent article has a racetrack-like plan view configuration with straight longitudinal side edges and convexly curved end edges.

The absorbent article is preferably substantially smaller than conventional sanitary napkins. For example, the absorbent article may have an overall length when measured in its curved configuration of less than or equal to about 6 or 7 inches (about 15 cm to 18 cm), or even less than or equal to about 5 inches (about 12.7 cm), and a width of less than or equal to about 3 inches (about 7.6 cm). In one preferred embodiment the absorbent article measures about 6 inches (about 15 cm) by about 3 inches (about 7.6 cm). The absorbent article preferably has a surface area measured in flat condition and exclusive of any flaps, wings, or side wrapping elements that can be less than or equal to about any of the following: about 20 in^2 (about 130 cm^2); about 18 in^2 (116 cm^2); about 15 in^2 (about 97 cm^2 (or 100 cm^2)); about 12.5 in^2 (about 80 cm^2); or about 10 in^2 (about 65 cm^2).

The absorbent article is preferably highly flexible, and preferably has a flexure resistance of less than or equal to about 100 grams, more preferably less than or equal to about 70 grams, and most preferably between about 30 and about 50 grams. This allows the absorbent article to conform very closely to the wearer's body. It also allows the absorbent article to conform to the shape assumed by the crotch region of the specially designed supporting garment. In other words, the absorbent article will bend under the body-contacting forces (described in greater detail below) applied by the supporting garment, and will not "overpower" the second skin fit of the supporting garment. The small size and high flexibility also provides the absorbent article with improved comfort.

The absorbent article 200 is preferably also highly absorbent. The absorbent article preferably has a total capacity of greater than or equal to about 10 grams, more preferably about 20 grams or greater than or equal to about 25 grams of liquid. Total capacity is measured in accordance with the method described in the Test Methods section of this specification. It is particularly desirable that the portion of the absorbent article 200 that is placed adjacent to the wearer's vaginal orifice have the aforementioned capacity, particularly a region which measures 2 inches by 5 inches (5 cm by 13 cm) which would be centered under the vaginal orifice when the absorbent article is worn. To determine the capacity for this 2 inch by 5 inch area, a rectangular area having such dimensions is cut from the portion of the absorbent article to be tested that would be centered under the vaginal orifice. The test is run on this 2 x 5 portion of the absorbent article in the same manner as the capacity test described in the Test Methods section of this specification. If

the absorbent article is smaller than 2 inches by 5 inches in this region, then a sample of the absorbent article which would lie within a 2 inch by 5 inch rectangle is used.

The highly efficient nature of the absorbent article may also be expressed in terms of the ratio of the total capacity of the absorbent article to the surface area of the absorbent article. In some preferred embodiments, the absorbent article preferably has a ratio of total capacity to surface area (the latter being measured in a flat condition) of greater than or equal to about 2 (g/in^2) (about 0.30 g/cm^2), more preferably greater than or equal to about 2.5 (g/in^2) (about 0.39, or about 0.40 g/cm^2). By way of comparison, the capacity to surface area ratio of an ALWAYS ULTRA thin sanitary napkin sold by The Procter & Gamble Company of Cincinnati, Ohio is about 1.7 (g/in^2) (about 0.26 g/cm^2). The absorbent article 200 is highly efficient, having an overall capacity greater than or equal to a current ultra thin sanitary napkin, while being roughly half the size.

The embodiment of the absorbent article 200 shown in Fig. 12 preferably comprises at least three primary components. These include a liquid pervious topsheet, a liquid impervious backsheet, and an absorbent component, such as absorbent core positioned between the topsheet and the backsheet. The liquid pervious topsheet, the liquid impervious backsheet, and the absorbent core can comprise a number of suitable materials, provided that the absorbent article 200 has the overall characteristics described herein.

It should also be understood that the absorbent article 200 is not limited to structures which have these three primary components. Embodiments can be provided which only have one or two of these components. For example, the absorbent article 200 need not have a topsheet if the body-facing surface of the absorbent core is suitable for use as a topsheet. A liquid impervious component, such as a liquid impervious backsheet, could be joined to the other side of the absorbent component. Alternatively, the absorbent article 200 can comprise an absorbent component that has a liquid pervious side and a liquid impervious side. The liquid impervious side can be provided by treating the garment surface of the absorbent component to render it liquid impervious.

The liquid pervious side defines the body-contacting surface of the absorbent article 200. In some preferred embodiments, the liquid pervious side comprises a plurality of elements extending outward from the body-contacting surface of the absorbent article 200. That is, if the body-contacting surface is considered to lie within the X-Y plane in a Cartesian coordinate system, these elements will extend outward from this plane in the Z-direction. These elements can form any suitable angle with the body-contacting surface of

the absorbent article 200. The elements can comprise any suitable type of components, including, but not limited to fibers.

In one preferred embodiment, the liquid pervious topsheet comprises a high loft fibrous material. The term "high loft fibrous material", as used herein, refers to a low density, but relatively high caliper, fibrous material. The high loft fibrous material preferably has a density of less than or equal to about 0.01 g/cm^3. The high loft fibrous material preferably has a caliper of greater than or equal to about 1/8 inch (about 3.2 mm), more preferably between about 1/4 inch (about 6.4 mm) and at least about 1/2 inch (about 13 mm). The high loft fibrous material preferably has a basis weight of less than or equal to about 4 or 5 oz./square yard (about 142 $grams/m^2$). These calipers and densities were measured under INDA standard test method IST 720.1-92, which specifies measuring caliper under a pressure of 0.005 psi. (350 Pa).

The high loft fibrous material is preferably comprised of fine polymeric fibers, which preferably have a denier per fiber of less than or equal to about 6. The high loft fibrous topsheet material serves several functions. It allows the absorbent article to achieve a "macro" fit that is capable of fitting virtually all women, and a "micro" fit that adjusts to the particular body contours (which may be in the form of rugosities) of individual women. Another advantage of the high loft topsheet is that it is very soft and "cushiony". The high loft topsheet also is advantageous because it has a low coefficient of friction against the wearer's body due to the discrete contact of the individual fibers comprising the same with the wearer's body.

In addition, it is often assumed that leakage of menses from conventional sanitary napkins occurs primarily as a result of the capacity of absorbent articles being exceeded. However, it has been found that a substantial number of soiling accidents occur as a result of menstrual fluid that does not even enter the sanitary napkin. Often these soiling accidents result from menses which flows adjacent to the wearer's body, and which may flow in or close to the wearer's pubic hair. A high degree of "loft" is preferred so that the fibers of the topsheet will get into close contact with the wearer's body and between the wearer's pubic hairs. The high loft topsheet tends to break the flow of menses along the wearer's body, and intercepts menses flowing along the wearer's body, and allows such bodily exudates to be acquired into the absorbent core. Such high loft topsheets provide a capillary structure the effectively competes with the wearer's body for bodily fluids, such as menses, and directs such fluids into the absorbent article. A good indicator of whether

an absorbent article has a body-contacting surface with Z-direction oriented elements is whether the elements on the body-contacting surface are capable of penetrating between the wearer's pubic hairs. Conversely, if the elements comprising the body-contacting surface of the absorbent article lie flat against the wearer's pubic hairs, and compress the pubic hairs, this is an indication that the absorbent article does not have a body-contacting surface with Z-direction oriented elements.

In preferred embodiments, the high loft topsheet comprises a thermally bonded polyester fibrous nonwoven material having a caliper of about 4 mm and a basis weight of about 1.5 oz./yd^2 (about 50 grams/m^2). The fibers of this high loft topsheet material are preferably in a random orientation. One particularly preferred material for the high loft topsheet has a caliper of 4.1 mm, and a density of 0.0077 g/cm^3, and is obtained as product code #W-4635 from Stearns Technical Textile of Cincinnati, Ohio. Another preferred high loft topsheet material has a caliper of 5.8 mm, and a density of 0.0098 g/cm^3 (after rebulking), and is obtained as product code r #68317 (rebulked) from Fibertex A/S, Box 8029, Svendborgvej 16, DK-9220 Aalborg Ost, Denmark. If the high loft topsheet material has one side that is relatively flat, and one side that is "fluffy", it is preferred that the flat side be oriented toward the absorbent core.

The fibers of the high loft topsheet material are preferably slightly hydrophobic. Once bodily exudates contact the fibers of the high loft topsheet, they are transported down through the high loft topsheet and penetrate very quickly into the absorbent core. For example, the high loft topsheet may have an acquisition rate of from about 0.27 ml/sec. to about 0.75 ml/sec., while current apertured formed films, such as the DRI-WEAVE topsheet material described below, may have an acquisition rate of about 0.15 ml/sec. The fibers, although thin, lay on top of one another to form a top layer with large openings therein. Menses falls through the large openings between the fibers of the high loft topsheet into the underlying absorbent core. The high loft topsheet material has considerable depth and, as a result, is able to keep the wearer's body relatively dry (or reduce "rewet") by spacing the absorbent core (and liquids held therein) away from the wearer's body.

In other embodiments, the fibers of the high loft topsheet may have a degree of hydrophilicity, or may be treated with a surfactant to provide them with a degree of hydrophilicity. This may allow the fibers to more effectively draw menses away from the wearer's skin.

In still other embodiments, the liquid pervious topsheet may comprise an apertured film, such as an apertured formed film. Suitable formed films are described in U.S. Pat. No. 3,929,135, issued to Thompson on December 30, 1975; U.S. Pat. No. 4,324,245, issued to Mullane, et al. on April 13, 1982; U.S. Pat. No. 4,342,314, issued to Radel, et al. on August 3, 1982; U.S. Pat. No. 4,463,045, issued to Ahr, et al. on July 31, 1984; and U.S. Pat. No. 5,006,394, issued to Baird, on April 9, 1991. One especially preferred material for the topsheet comprises a formed film described in one or more of the above patents and marketed on sanitary napkins by The Procter & Gamble Company of Cincinnati, Ohio as the "DRI-WEAVE" topsheet. The topsheet preferably has a hydrophilic surfactant incorporated therein during manufacture.

Other preferred apertured films suitable for use as the topsheet are the apertured films made in accordance with U.S. Patents 4,609,518 and 4,629,643, the latter entitled "Microapertured Polymeric Web Exhibiting Soft and Silky Tactile Impression", both issued to Curro, et al., on September 2, 1986, and December 16, 1986, respectively, and cloth-like formed films made in accordance with U.S. Patent 4,637,819 entitled "Macroscopically Expanded Three-Dimensional Polymeric Web for Transmitting Both Dynamically Deposited and Statically Contacted Fluids From One Surface to the Other", which issued to Ouellette, et al. on January 20, 1987; and U.S. Patent Application Serial No. 08/442,935 entitled "Fluid Transport Webs Exhibiting Surface Energy Gradients" filed in the name of Ouellette, et al. on May 31, 1995 (PCT Publication WO 96/00548, published January 11, 1996).

If such an apertured film topsheet material is used, it can be used as the topsheet *per se*. Preferably, however, it is used in conjunction with high loft topsheet material wherein the high loft topsheet material overlies such an apertured film. The apertured film, if properly apertured, will provide a reduced tendency for liquids to pass back through and rewet the wearer's skin. Combining both the high loft topsheet material and the cloth-like apertured formed film adds additional thickness to the above-described high loft layer and further spaces the absorbent core and liquids therein from the wearer's body, further contributing to keeping the wearer's body dry.

The absorbent core may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, oval, hourglass, dog bone, asymmetric, etc.) and from a wide variety of liquid-absorbent materials commonly used in sanitary napkins and other absorbent articles. The absorbent core, however, should preferably be adapted so that it has the capacity specified

herein. Examples of suitable absorbent materials include comminuted wood pulp which is generally referred to as airfelt; creped cellulose wadding; meltblown polymers including coform; chemically stiffened, modified or cross-linked cellulosic fibers, synthetic fibers such as crimped polyester fibers; peat moss; tissue including tissue wraps and tissue laminates; absorbent foams; absorbent sponges; superabsorbent polymers; absorbent gelling materials; or any equivalent material or combinations of materials, or mixtures of these. The configuration and construction of the absorbent core may also be varied (e.g., the absorbent core may have varying caliper zones (e.g., profiled so as to be thicker in the center), hydrophilic gradients, superabsorbent gradients, or lower density and lower average basis weight acquisition zones; or may comprise one or more layers or structures. Examples of suitable absorbent core materials with sufficient capacity are described below.

In a particularly preferred embodiment, the absorbent core comprises a high loft needle punched nonwoven material comprising rayon fibers and fibrous superabsorbent hydrogel-forming polymeric material. Such an absorbent core preferably comprises between about 50% to about 70%, preferably about 65% staple length viscose rayon fibers, and between about 30% and about 50%, preferably about 35% fibrous superabsorbent hydrogel-forming polymeric material. (Unless otherwise stated, all percentages specified herein are based upon weight.) Suitable viscose rayon fibers are LYOCELL viscose rayon fibers, type 18453, obtained from Courtaulds Fibers, Inc. of North Axis, Alabama. Suitable fibrous superabsorbent hydrogel-forming polymeric material is the FIBERDRI fibrous superabsorbent material described below. The high loft needle punched nonwoven material preferably has a basis weight of about 90 g/m^2. This nonwoven material is preferably needle punched with about 60 needles/cm^2, or more. The more needles used, the higher will be the flexibility of the finished material.

A suitable fibrous superabsorbent, hydrogel-forming polymeric material is sold as FIBERDRI superabsorbent by Camelot Technologies Ltd. of High River, Canada. The FIBERDRI fibrous superabsorbent material is preferred because it has more capacity than many current particulate superabsorbent materials. For example, it may have a capacity of about 25 grams of liquid per gram of superabsorbent material, whereas current particulate superabsorbent materials may have a capacity of about 20 grams/gram. The FIBERDRI material, thus, provides the advantage that a relatively small amount (for example, about 0.7 grams) of the FIBERDRI material will provide a total amount of capacity for the small

sized absorbent core used in the present invention, which is equal to or greater than the total amount of capacity of full-sized sanitary napkins.

Although a single layer of this high loft material can be used for the absorbent core, preferably at least two layers are used. More than two layers can be used, particularly if the high loft material is made in lower basis weights. The layers may be joined together, if desired. However, it has been found that the layers are adequately retained in position relative to each other when they are simply placed adjacent to each other. This is believed to be due to the fiber entanglement between the fibers on the surfaces of the layers.

The backsheet can be any suitable flexible, liquid impervious material. Preferably, the backsheet is a polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.015 mm (2.0 mil). Exemplary polyethylene films are manufactured by Clopay Corporation of Cincinnati, Ohio, under the designation P18-0401 and microflex 1401. The backsheet may be embossed and/or matte finished to provide a more clothlike appearance.

Further, the backsheet may permit vapors to escape from the absorbent core (that is, it may be breathable) while still preventing exudates from passing through the backsheet. A suitable breathable backsheet material comprises an adhesively attached laminate of an apertured film having tapered capillaries, such as that described in U.S. Patent 3,929,135 issued to Thompson on December 30, 1975, and a microporous film. A suitable microporous film is supplied by Exxon Chemical USA, and described in Exxon's U.S. Patent 4,777,073. The breathable backsheet is arranged so that the smaller openings of the tapered capillaries face the absorbent core. The microporous film is joined to the side of the apertured film having the larger openings to form the garment-facing surface of the absorbent article.

The use of a breathable backsheet in conjunction with the menstrual panty, which preferably has a breathable crotch portion, allows the overall breathability of the system of the absorbent article and the menstrual panty to be controlled and set to an optimal level. This eliminates any variances caused by using the absorbent article randomly with commercially available undergarments that have different amounts of vapor permeability and non-permeability.

The topsheet, the backsheet, and the absorbent core may be assembled in a variety of configurations known in the art (including layered or "sandwich" configurations and wrapped or "tube" configurations). In the preferred embodiments shown in the drawings,

the absorbent article 200 is assembled in a sandwich construction in which the topsheet and the backsheet have length and width dimensions generally larger than those of the absorbent core. The topsheet and the backsheet extend beyond the edges of the absorbent core to form portions of the periphery.

The topsheet may be joined to the body-facing side of the absorbent core. In other embodiments, the topsheet need not be joined to the absorbent core to enhance the flexibility of the absorbent article 200. The term "joined", as used herein, encompasses configurations in which an element is directly secured to another element by affixing the element directly to the other element; configurations in which the element is indirectly secured to the other element by affixing the element to intermediate member(s) which in turn are affixed to the other element; and configurations in which one element is integral with another element, i.e., one element is essentially part of the other element. The backsheet need not be, and preferably is not, joined to the absorbent core to enhance the flexibility of the absorbent article 200. The portions of the topsheet and backsheet that extend beyond the edges of the absorbent core to form the periphery, are preferably joined to each other.

If the topsheet is joined to the absorbent core, the topsheet can be joined to the absorbent core in any suitable manner known in the art for this purpose. The topsheet may be joined to the absorbent core by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. One adhesive that has been found to be satisfactory for this purpose is manufactured by Findley Adhesive Company of Wauwatosa, Wisconsin as adhesive number 2031. The adhesive is preferably applied an open pattern network of filaments of adhesive such as is disclosed in U.S. Patent 4,573,986 entitled "Disposable Waste-Containment Garment", which issued to Minetola, et al. on March 4, 1986. Other exemplary open pattern networks of adhesive filaments comprising several lines of adhesive filaments swirled into a spiral pattern are illustrated by the apparatus and methods shown in U.S. Patent 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent 4,842,666 issued to Werenicz on June 27, 1989. Alternatively, the components of the absorbent article may be joined by heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art. The portions of the topsheet and backsheet

that extend beyond the edges of the absorbent core to form the periphery, can be joined to each other in any of the manners described herein.

The components of the absorbent article can be described as forming a "unitary structure." The term "unitary structure", as used herein, refers to a construction in which the components are joined together, or integrated together as a unit. The term "unitary structure" includes constructions such as those described above where the topsheet, absorbent core, and backsheet comprise separate components that are joined together. It also covers constructions in which the liquid pervious side and liquid impervious side of the absorbent articles do not comprise a separate topsheet and/or backsheet. For example, in the latter case, the liquid pervious side, the liquid impervious side, or both, may comprise a surface of the absorbent core that has the desired characteristics, rather than a separate component.

The garment-facing surface of the absorbent article 200 may include, and preferably does include a fastener for attaching the absorbent article to the specially designed supporting undergarment. Fasteners comprising adhesives, particularly pressure sensitive adhesives, which have been used to secure absorbent articles, such as sanitary napkins, to the crotch region of conventional panties can be used for this purpose.

Preferably, however, the garment-facing surface of the absorbent article 200 comprises a mechanical fastening material that is particularly suitable for engaging knit materials, such as the material from which the supporting undergarment is preferably made. The mechanical fastening material can be located on any suitable portion of the garment surface. The mechanical fastening material could cover all, or any other suitable portion of the garment-facing surface of the absorbent article. The mechanical fastening material can be distributed in any suitable pattern across the garment surface. The mechanical fastening material can be distributed in a pattern that matches the pattern of one or more pre-selected portions of the specially designed supporting garment. For example, the mechanical fastening material can be arranged in a pattern that corresponds to and aligns with the longitudinal stretch control member and/or the angled stretch control members of the menstrual undergarment The alignment of the mechanical fastening material with these portions of the supporting garment can be used as a placement aid to ensure that the absorbent article 200 is positioned properly in the supporting garment. The pattern of mechanical fastening material can also be used to assist the absorbent article 200 in fitting closely against the wearer's body in certain areas.

The mechanical fastening material provides the garment surface of the absorbent article with a fastener that is capable of easily adhering to knit material, and has a sufficiently high holding force even if the supporting garment stretches and contracts. The mechanical fastening material described herein is particularly preferred for use with the specially designed knit supporting undergarment since it will not become detached when the supporting garment stretches and contracts during application of the absorbent article to the undergarment, as will some pressure sensitive adhesives.

Methods suitable for forming certain types of mechanical fastening material are described in greater detail in U.S. Patent 5,392,498 issued to Goulait, et al. on February 28, 1995. In another embodiment, the mechanical fastening material can comprise a material having a "T"-shaped or mushroom-shaped appearance when viewed from the side. One particularly preferred "T"-shaped mechanical fastening material for use on the absorbent article is a material known as TP200 available from 3M Personal Care and Related Products Division of Menomonie, WI.

The absorbent article 200 is utilized by placing the absorbent article 200 in the crotch portion of the menstrual undergarment. The absorbent article 200 is placed in the crotch portion of the menstrual undergarment with one end extending toward the front section of the menstrual undergarment and the other end towards the back section of the menstrual undergarment. The backsheet is placed in contact with the inner surface of the center of the crotch portion of the menstrual undergarment. The projections of the mechanical fastening material on the garment-facing side of the absorbent article engage with the knit material from which the crotch portion of the menstrual undergarment is made. The wearer then pulls on the menstrual undergarment. The menstrual undergarment will typically stretch and contract, until it fits as shown in the drawings.

The menstrual panty fits against the wearer's body so closely, particularly in the crotch region, that it is like a comfortable "second skin". The absorbent article 200 preferably does not alter or override the tendency of the menstrual panty to achieve this "second skin" fit. The absorbent article 200 is preferably sufficiently flexible so that it assumes a configuration similar to the crotch region of the menstrual panty. Preferably, the absorbent article 200 also conforms to the shape of the wearer's pudendal region in use. The absorbent article preferably conforms to the shape of the wearer's pudendal region regardless of whether the wearer's legs are together or apart.

The absorbent article 200 preferably flexes under the forces applied by the menstrual panty 38 that are used to hold the absorbent article comfortably against the wearer's body. If the absorbent article flexes under these forces, it will not override the tendency of the menstrual panty to achieve the desired fit, and the absorbent article 200 will assume a shape similar to the crotch region of the menstrual panty. As discussed herein, the menstrual panty preferably applies body-contacting pressures to the wearer's body of less than or equal to about 20 g/cm^2, more preferably less than or equal to about 15 g/cm^2. A body-contacting pressure of 20 g/cm^2 applied by the menstrual panty, is a pressure which is high enough that it is on the borderline of being uncomfortable for the wearer.

It is recognized that there are other garments, such as Japanese menstrual shorts, that are close fitting. However, such garments tend to apply forces that uncomfortable, particularly on the wearer's legs at those places where the wearer's legs are contacted by the elasticized edges of the menstrual shorts. The menstrual panty described herein, on the other hand, is particularly preferred because it is capable of applying body-contacting forces along the crotch region thereof which keep the absorbent article 200 in close contact with the wearer's pudendal region without creating uncomfortable forces on the wearer's legs (greater than or equal to about 20 g/cm^2) at the places where the wearer's legs are contacted by the leg openings of the menstrual panty. Preferably, the edges of the crotch region of the menstrual panty described herein apply a body-contacting pressure to these regions of the wearer's body that is less than or equal to about 20 g/cm^2.

The absorbent article 200 and menstrual panty also differ from prior sanitary napkins and conventional underwear in the sustained nature of the contact of the absorbent article with the wearer's body. Some current sanitary napkins may occasionally assume a "W"-shaped cross sectional configuration during wear, such as when the wearer is sitting. However, conventional underwear does not provide a constant force against the wearer's body to hold the sanitary napkin in place under all circumstances, such as when the wearer is walking or standing, or when the wearer's legs are apart. The absorbent article and the menstrual panty, on the other hand, provide such sustained contact with the wearer's body. The absorbent article may be described as being substantially maintained in sustained contact with the wearer's body, in which case the absorbent article need not be in complete and/or continuous contact with the wearer's body, but is maintained in contact with the wearer's body more than it is out of contact with the wearer's body.

Current sanitary napkins are typically worn in a loose-fitting undergarment. Such sanitary napkins are necessarily designed to be large enough so that in the event of any shifting of the sanitary napkins from their position under the vaginal introitus, they will still be able to intercept the wearer's bodily discharges.

It has been theorized by the inventors that if an absorbent article with sufficiently high capacity is held closely but comfortably against the wearer's pudendal region, and in particular, covers the vaginal introitus, the surfaces of the labia majora, and perineum, during the entire period throughout which the absorbent article is worn, then an absorbent article can be provided which is of a greatly reduced size in comparison to current sanitary napkins. Such an absorbent article need only be large enough to cover these regions of the wearer's body, rather than being sized to accommodate shifting of the product with respect to the introitus. The absorbent article and menstrual panty preferably function in a manner that can be thought of as being analogous to covering a cut with a bandage. Body fluids are captured at or near their source by using close body contact and comfortable forces to hold the absorbent article in place at the source of bodily fluids. This can be contrasted with using overly-sized sanitary napkin in a loose-fitting pair of panties, which function in a manner that can be analogized to the use of a drop cloth beneath the source of bodily fluids.

The absorbent article 200 preferably is capable of maintaining contact with and covering at least a portion of the inside surfaces of the wearer's labia, at least a portion of the exterior surfaces of the wearer's labia, and at least a portion of the menstrual panty. The absorbent article 200 preferably covers an area of the wearer's body that is centered about the wearer's labia and has a projected width of at least about 1 inch (about 2.5 cm). The absorbent article may cover substantially all of the interior surfaces of the wearer's labia up to and including contacting and covering the floor of the wearer's vestibule. The absorbent article may also cover substantially all of the exterior surfaces of the wearer's labia.

Another way of describing the configuration the absorbent article 200 may take during wear is by looking at the different regions of the absorbent article 200. The absorbent article 200 preferably has a longitudinal central region centered about its longitudinal centerline that is capable of being positioned in the space between the wearer's labia. This longitudinal central region may be of any suitable width that is less than the width of the entire absorbent article. The longitudinal central region may extend the full length of the absorbent article 200, or less than the full length of the absorbent article. The

longitudinal central region preferably has at least a portion (typically along the longitudinal centerline of the absorbent article) that is capable of residing in the space between the wearer's labia at an elevation that is higher (when the wearer is standing) than at least some portions of the absorbent article that are located laterally outboard of the longitudinal central region. The absorbent article 200 is preferably capable of assuming such a configuration without compression by the inner portions of the wearer's thighs.

The absorbent article 200 preferably cups the labia from front to back. Preferred embodiments of the absorbent article 200 are sufficiently small that they only cover the wearer's pudendal region and immediately adjacent regions, and in particular, cover the vaginal introitus and the surfaces of the labia majora. The absorbent article 200 may also cover the wearer's perineum. The absorbent article may cover the wearer's clitoris, but preferably does not extend substantially forward beyond the wearer's mons pubis. The absorbent article 200 may be spaced slightly away from the clitoris, or it may fit closely against the clitoris, as it does relative to the other regions of the wearer's body. The absorbent article 200 preferably does not extend rearward to contact the wearer's anus to avoid sensitive nerve endings therein. When the absorbent article 200 is of this preferred size, it provides a more comfortable, and less noticeable absorbent article since it occludes less of the crotch region of the wearer's body and allows air to circulate around the same.

The absorbent article 200 also preferably does not cover areas of the wearer's body that undergo substantial degrees of movement (that is, the absorbent article will only be placed adjacent to "low motion zones" of the wearer's body). In particular, it is desirable that the side edges of the absorbent article 200 will not be contacted by the inside surfaces of the wearer's thighs when the wearer walks, or otherwise moves about. This overcomes a drawback of conventionally-sized sanitary napkins and pantiliners, which being comparatively stiff relative to the absorbent article 200 for use in the system of the present invention, will transfer forces applied to the edges thereof to other portions of the sanitary napkin or pantiliner, causing the same to bend or crumple, and/or shift from the desired position under the wearer's vaginal introitus.

The absorbent article 200 can be made somewhat larger if the edge portions thereof which may be contacted by the inside surfaces of the wearer's thighs do not translate forces acting thereon to the remainder of the absorbent article so as to cause the absorbent article to bend or crumple, and/or shift from the desired position under the wearer's vaginal introitus. For example, it is also contemplated herein that an absorbent article 200 can be

constructed which has the desired flexibility, fit, and an absorbent region with the preferred small size described herein (e.g., covering the pudendal region and the perineum), but which has regions that are located outboard of these regions which merely serve a "drop cloth" function, which have minimal or no absorbency. For instance, such regions could be comprised only of topsheet and backsheet materials, and possibly a thin layer of absorbent material therebetween. It is considered that such an embodiment will also fall within the scope of the present invention.

Alternatively, the absorbent article 200 can have a region, typically in the center thereof, that is stiffer than the portions of the absorbent article that lie outboard of this center region. In other words, the absorbent article 20 may have a central low motion area which has a greater thickness and less flexibility than the regions of the absorbent article that are in higher motion areas (the higher motion areas are those areas which might be contacted by the insides of the wearer's thighs). In each of these embodiments, the absorbent article 20 preferably does not shift more than about 1.5 inches (about 3.8 cm), more preferably about 1 inch (about 2.5 cm), and most preferably about 0.5 inch (about 1.3 cm) from its position relative to the wearer's vaginal introitus when the absorbent article 20 is worn in the supporting garment during the following protocol.

For the purposes of determining how far the absorbent article shifts relative to the wearer's vaginal introitus, a five minute walking protocol is used. The wearer should place the absorbent article in the menstrual undergarment, and pull the menstrual undergarment in place. The wearer can then indicate where her vaginal introitus is by pointing with her finger to the outside surface of the menstrual undergarment. This portion of the undergarment is marked with a suitable washable felt tip marker. If desired, marks can also be made on one or more portions of the periphery of the absorbent article 20, and corresponding marks can be made on the immediately adjacent portions of the wearer's body. The wearer then walks normally for five minutes. After this period of walking, the wearer again indicates where her vaginal introitus is, and this position is marked. The distance that the marks are apart after the wear cycle is the amount that the absorbent article has shifted.

As discussed above, the absorbent article may have a region, typically in the center thereof, that is thicker (and possibly stiffer) than the portions of the absorbent article that lie outboard of this center region. The absorbent article may have a raised portion on its body-facing side. The raised portion is preferably centered relative to the longitudinal centerline

of the absorbent article. The raised portion may extend any desired portion of the length of the absorbent article, up to the full length of the absorbent article. The raised portion can be formed by a variety of different types of structures. In some embodiments, the raised portion can comprise a tube of absorbent material that is joined to the liquid pervious side of the absorbent article to form a compound absorbent article. In other embodiments, the raised portion can comprise a hump-forming element, which may underlie the liquid pervious topsheet. Examples of absorbent articles having a raised portion on their body-facing side are described in commonly assigned, copending patent application Serial No. _____, filed in the names of Carstens, et al. on the same date as the present application (Attorney's Docket Number Case 6923M), the disclosure of which is incorporated herein by reference.

Providing an absorbent article with a raised portion is a less preferred embodiment for use with a menstrual undergarment such as that shown in the drawings which has an extensible lifting strip along its longitudinal centerline. The lifting strip places the absorbent article in close contact with the wearer's body in the space between the wearer's labia without providing a raised portion on the body-facing surface of the absorbent article.

However, in some cases, the menstrual undergarment may be provided with a wider lifting zone that spans the distal surfaces of the wearer's labia. This wider zone may not rise convexly upward to enter the space between the wearer's labia. In such a case, a raised portion on the body-facing side of the absorbent article will preferably work in conjunction with the menstrual undergarment as shown to provide the desired interlabial fit.

Optional Features

When used as a system with a catamenial device 200, the menstrual undergarment 20 for use in the system of the present invention can also comprise a fastening system for reliably securing the catamenial device 200 on the crotch panel 50. For example, the catamenial device 200 could be provided with a first portion of a cohesive material and the crotch panel 50 could be provided with a second portion of a cohesive material. As used herein, a "cohesive material" is one which preferentially adheres to itself and not to other materials.

Alternatively, the garment-facing surface of a catamenial device 200 designed for use with the undergarment 20 for use in the system of the present invention could comprise a skin-friendly mechanical fastening material comprising a substrate or surface with an array

of prongs in the form of a plurality of small filamentous (or hair-like) projections disposed thereon as described in copending application Serial No. 60/065,294, filed on November 13, 1998, in the names of Carstens, et al., the disclosure of which is incorporated herein by reference. Such projections are capable of easily adhering to knit material (e. g. the crotch panel 50 of the of the undergarment for use in the system of the present invention), and have a sufficiently desirable holding force even if the supporting garment stretches and contracts.

The crotch panel 50 can also optionally be provided with indicia (not shown) to help a wearer optimally position a catamenial device 200 therein. For example, such indicia can comprise markings on the leg elastics that would allow a wearer to properly locate any flaps that may be provided on a catamenial device 200 for use therewith. Alternatively, such indicia could comprise markings along the longitudinal centerline L that would allow a wearer to reliably position a catamenial device 200 each time a new device is disposed on the body contacting (i.e. inner) surface of the crotch panel 50.

Forming the Undergarment

A blank for the menstrual undergarment 20 is first knit in a tubular form using means known to the art. In particular, front panel 30, the rear panel 40, the crotch panel 50 are integrally knit. The rear panel 40 is provided with a lifting member 42 by having such a strip integrally knit therein. Similarly, the crotch panel 50 is provided with an integrally knit longitudinal stretch control member 52 and, preferably, a plurality of angled stretch control members 54. The appropriate knit patterns as described above are used.

The tubular blank is then slit walewise and opened. Excess material that would otherwise fill the leg openings 60 is removed to form a flat blank for the menstrual undergarment 20 having a shape similar to the plan view of the menstrual undergarment 20 that is shown in Figure 11. As is further shown in Figure 11, the blank for the menstrual undergarment has a front end edge 23, a rear end edge 24, front side edges 25, 26, and rear side edges 37A, 37B.

The leg elastics 62 are joined to the undergarment 20 about the periphery of the leg openings 60 as discussed above. The blank for the menstrual undergarment 20 is then folded about the transverse centerline T and opposing portions of the side edges that lie between the leg opening 60 and the end edges 23, 24 are joined (eg by sewing the edges) to

form side seams 32, 34 completing the assembly of menstrual undergarment 20 (That is, the portion of side edge 25 that lies between the end of the leg elastic 62 in front panel 30 and the end edge 24 is joined to the portion of side edge 27 that lies between the end of the leg elastic 62 that lies in the rear panel 40 and the end edge 23 to form seam 32. Side edge 26 is joined to side edge 28 in a similar manner to form seam 34).

Alternatively, portions of the tubular knit blank can be cut out to provide the leg openings 60. For example, a tubular blank can be flattened, such that, the interior faces thereof contact each other and a pair longitudinally oriented side edges are formed. Leg opening precursors can then be formed by cutting matching portions having a semi-circular, semi-elliptical, or other desired shape from transversely opposite side edges at regular intervals along the flattened blank. Undergarment blanks are then formed by transversely cutting the flattened tubular blank in a predetermined repeat pattern wherein a first transverse cut is made across the material that was not removed when the leg opening precursors were formed to create a crotch portion precursor and a second transverse cut is made across the full width of the flattened tubular blank forming the waist opening 21. The leg elastics 62 are disposed about the periphery of each leg opening 60 and joined thereto. The two ends formed by the first transverse cut are joined by a single transverse seam to complete the crotch panel 50. The menstrual undergarment 20 is then finished by disposing the elasticized waistband 22 about the periphery of the waist opening 21 and joining the elasticized waistband 22 thereto.

The following examples serve to point out the particular benefits of various aspects for use in the system of the present invention.

EXAMPLES

Example 1

This example is intended to demonstrate the "second skin" fit of the undergarment 20 for use in the system of the present invention. Specifically, frontal photographs of the crotch region of the undergarment for use in the system of the present invention and of a prior art knit undergarment were taken while a medical model wore each of the undergarments. The photographs were taken with the model standing with her legs in two positions: 1) a closed position (10 mm gap between the thighs) and 2) a spread position (50 mm gap between thighs). All photos were taken at a distance of 1 foot (30 centimeter) from the model's pudendal area.

Figures 7 and 8 show the undergarment for use in the system of the present invention when the model's legs were in a closed and open position. Figures 9 and 10 show the same model in the same two positions wearing a knit undergarment of the prior art (Fruit of the Loom® available from Fruit of the Loom, Inc. of Bowling Green, KY). The results of this test are discussed in the Crotch Panel section above.

Example 2

This example is intended to show a comparison of body contact force among undergarments according to the present invention and several prior art undergarments.

Samples of the undergarment for use in the system of the present invention and several prior art undergarments were evaluated for body contact force according to the method described in the TEST METHODS section. The results of this experiment are given in Table 2.

Table 2

Body Contact Force Comparison

Undergarment	Garment Type	Body Contact Force Centerline (grams/cm^2)	Body Contact Force Labia Majora (grams/cm^2)	Force Ratio
Present Invention	N/A	2.35	1.33	1.76
Wing EC 8302[1]	A	1.94	2.58	0.75
Wing EC 8400[1]	A	1.10	1.57	0.70
Fruit of the Loom[3]	B	0.006	0.68	0.01
Wacoal[2]	C	0.50	2.52	0.20
Wonder Body™[4]	C	0.07	0.77	0.09
Olga 2903-28[5]	C	0	0.50	0
Olga 2903-18[5]	C	0	0.29	0

1. Available from Wacoal Corp. of Kyoto, Japan
2. Available from Wacoal Corp. of Kyoto, Japan
3. Available from Fruit of the Loom, Inc., Bowling Green, KY
4. Available from Sara Lee Intimates, Winston-Salem, NC
5. Available from Olga, Company, Van Nuys, CA

A Japanese Menstrual Short

B Unelasticized Panty

C Elasticized Panty

The differences in the ratio of the body contact force along the centerline and the labial force among the products is clear.

TEST METHODS

Flexure-Resistance

The flexure-resistance of an absorbent article is measured by peak bending stiffness. Peak bending stiffness is determined by a test which is modeled after the ASTM D 4032.82 Circular Bend Procedure, the procedure being considerably modified and performed as follows: The Circular Bend Procedure is a simultaneous multi-directional deformation of a material in which one face of a specimen becomes concave and the other face becomes convex. The Circular Bend Procedure gives a force value related to flexure-resistance, simultaneously averaging stiffness in all directions.

Apparatus

The apparatus necessary for the Circular Bend Procedure is a modified Circular Bend Stiffness Tester, having the following parts:

A smooth-polished steel plate platform which is 102.0 X 102.0 X 6.35 millimeters having an 18.75 millimeter diameter orifice. The lap edge of the orifice should be at a 45 degree angle to a depth of 4.75 millimeters.

A plunger having an overall length of 72.2 millimeters, a diameter of 6.25 millimeters, a ball nose having a radius of 2.97 millimeters and a needle-point extending 0.88 millimeter therefrom having a 0.33 millimeter base diameter and a point having a radius of less than 0.5 millimeter, the plunger being mounted concentric with the orifice and having equal clearance on all sides. Note that the needle-point is merely to prevent lateral movement of the test specimen during testing. Therefore, if the needle-point significantly adversely affects the test specimen (for example, punctures an inflatable structure), then the needle-point should not be used. The bottom of the plunger should be set well above the top of the orifice plate. From this position, the downward stroke of the ball nose is to be the exact bottom of the plate orifice.

A force-measurement gauge and more specifically an Instron inverted compression load cell. The load cell has a load range of from about 0.0 to about 2000.0 grams.

An actuator, and more specifically the Instron Model No. 1122 having an inverted compression load cell. The Instron 1122 is made by the Instron Engineering Corporation, Canton, Mass.

Number and Preparation of Specimens

In order to perform the procedure for this test, as explained below, five representative absorbent articles are necessary. From one of the five articles (having, of course, any panty adhesive release paper removed and any adhesive blocked) to be tested, some number "Y" of 37.5 X 37.5 millimeter test specimens are cut. Specimens having portions in which a topsheet is joined directly to a barrier sheet or which are a laminate of a topsheet, two or less tissue sheets and a barrier sheet, should not be tested. The reason that these specimens are not tested is due to the realization that prior art absorbent articles exist in which a topsheet is joined to a barrier sheet beyond the edges of an absorbent core in the periphery of the napkin, such portions of which are highly flexible. However, the present invention is more concerned with the overall flexibility of the absorbent article and not merely the peripheral portions thereof and, therefore, the flexibility of the present invention is more concerned with the flexibility of the significant absorbent portions of the absorbent article. If any of these significant absorbent portions of the absorbent article meet the parameters of this test, then the absorbent article satisfies the test. Therefore, a number of different specimens should be tested from each absorbent article. Certainly, the structurally most flexible portion of the absorbent article should be tested, excluding those portions excluded above. The test specimens should not be folded or bent by the test person, and the handling of specimens must be kept to a minimum and to the edges to avoid affecting flexural-resistance properties. From the four remaining absorbent articles, an equal number "Y" of 37.5 X 37.5 millimeter specimens, identical to the specimens cut from the first absorbent article, are cut. Thus, the test person should have "Y" number of sets of five identical specimens.

The procedure for the Circular Bend Procedure is as follows. The specimens are conditioned by leaving them in a room which is 21±1°C and 50±2% relative humidity for a period of two hours. The tests described herein are conducted under similar conditions. The test plate is leveled. The plunger speed is set at 50.0 centimeters per minute per full stroke length. A specimen is centered on the orifice below the plunger such that the body

surface of the specimen is facing the plunger and the garment surface of the specimen is facing the platform. Of course, any panty adhesive release paper (if present) is removed, to simulate in-use conditions. Any panty adhesive (if present) should be blocked, using means well known to those skilled in the art, such as glycerin and/or powder, to prevent the specimen from adhering to the platform and an artificially high peak bending stiffness being obtained. If desired, the specimen may be centered over the orifice with the body surface facing the platform and the garment surface facing the plunger to obviate the need for blocking any adhesive which may be present. The indicator zero is checked and adjusted, if necessary. The plunger is actuated. Touching the specimen during the testing should be avoided. The maximum force reading to the nearest gram is recorded. The above steps are repeated until all five of the identical specimens have been tested.

Calculations

The peak bending stiffness for each specimen is the maximum force reading for that specimen. Each set of five identical specimens is tested and the five values received for that set are averaged. Thus, the test person now has an average value for each of the "Y" sets tested. The flexure-resistance for an absorbent article is the greatest flexibility of these average peak bending stiffnesses.

Capacity

The total capacity of an absorbent article is determined as follows. Any panty adhesive release paper is removed from the article to be tested. The article is weighed to the nearest 0.1 gram. The article is then submerged in a beaker of sterile saline (obtainable from the Baxter Travenol Company of Deerfield, Illinois), such that the article is totally submerged and is not bent or otherwise twisted or folded. The article is submerged for 10 minutes. The article is removed from the saline and suspended for two minutes in a vertical position to allow the saline to drain out of the article. The article is then placed body facing surface down onto an absorbent blotter, such as the filter paper #631 available from the Filtration Science Corp., Eaton-Dikeman Division of Mount Holly Springs, PA. A uniform 17.6 grams per square centimeter load is placed over the article to squeeze excess fluid out. The absorbent blotter is replaced every 30 seconds until the amount of fluid transferred to the absorbent blotter is less than 0.5 grams in a 30 second period. Next, the article is

weighed to the nearest 0.1 gram and the dry weight of the article is subtracted. The difference in grams is the total capacity of the article. This concludes the test.

Lift Test

Introduction

This test involves the use of a lift measuring test apparatus that is shaped to roughly approximate the various areas of a female body that the sample must fit adjacent in order to achieve close body contact. The lift measuring test apparatus comprises two curved PLEXIGLAS pieces that are intended to approximate the portions of the wearer's body that the crotch of the wearer's undergarments contact during wear. The apparatus contains a longitudinally-oriented slit-like opening that is intended to approximate the space between the wearer's labia and the crevice between the wearer's buttocks (the "gluteal groove"). The sample is attached to clamps which are adjusted to simulate the forces exerted when a woman's panties are pulled up to the wearer's body. The distance that the middle of the sample vertically intrudes into the slit-like opening is measured to provide a relative measurement of body contact.

Apparatus

Lift Measuring Apparatus

The lift measuring test apparatus comprises six pieces of PLEXIGLAS arranged as shown in Figures 13–18. The Lift Test apparatus 100 has an inside surface 100A, an outside surface 100B, a front portion 100C, and a rear portion 100D.

The PLEXIGLAS pieces include two identical 1/4" thick arcuate pieces 102 and 104 which have a height H of 150 mm, a width W of 135 mm, a length S of 300 mm when assembled in an abutting relationship as shown in Figures 13–15, and a radius of curvature of the inner surface of the arcuate pieces, J (as shown in Figure 15), of 150 mm. A pair of rectangular PLEXIGLAS support legs 106 are mounted on the sides of the arcuate PLEXIGLAS pieces as shown in Figure 13. The support legs 106 are mounted perpendicularly to the arcuate pieces so that the bottom 108 of the arcuate pieces is held at least 20 mm above the table on which the test apparatus 100 is placed.

The arcuate pieces 102 and 104 are connected by a pair of hinges 110 that allow the arcuate pieces to open 90°. The arcuate pieces 102 and 104 are held together at the transverse centerline R of the test apparatus by a pivoting latch 112 when closed. The arcuate pieces have an 8 3/8 inch (212 mm) long central longitudinally-oriented slit-like opening (or "slit") 114 (as measured along the curvature of the outside surface 100B of the arcuate pieces) that varies linearly in width from 6 mm at the portion 114A of the slit located nearest to the front of the portion 100C of the test apparatus (the portion of the apparatus that is intended to represent the front of the wearer's body) to 19 mm at the portion 114B of the slit located nearest to the rear 100D of the apparatus. The portions of the PLEXIGLAS surrounding the slit 114 are beveled at a 45° angle so that the slit is wider on the bottom surface 100B than on the top surface of the arcuate pieces. Both ends of the slit 114 are rounded.

The arcuate pieces have additional channels to the front and rear of the slit 114 which are oriented along the longitudinal centerline of the slit. These channels provide a mechanism within which the bolts holding the clamps 118 can slide to adjust the position of the clamps relative to the slit. The arcuate pieces 102 and 104 are provided with tape 116 which can be marked with indicia to indicate the proper position for clamping the ends of the sample in clamps 118.

The front arcuate piece 102 of the test apparatus is also provided with a pair of three-dimensionally curved PLEXIGLAS pieces 120 that are intended to represent the wearer's labia majora. The curved pieces 120 have the configuration shown in Figures 15–18 and the dimensions shown in Table 3 below. The curved pieces are centered about the slit and are spaced 36 mm apart (on center) as described in Table 3 and their rear end edges 120B are spaced from the rear end edge of the first arcuate plate 102 that is defined by the 8° angle g described in Table 3.

TABLE 3 - Dimensions of Curved Pieces

Dimension	Size (in mm)
a	7 mm
b	16 mm
c	33 degrees
d	16 mm
e	6 mm (radius)
f	36 mm
g	8 degrees

Weights	Sufficient weight to place total weight of 391 grams on the sample (including weight of clamps (described below)).
Clamps	Spring-loaded, finger-operated 2 inch (5 centimeters) wide clamps (Boston No. 2 clips manufactured by Hunt Manufacturing Co., Statesville, N.C.) for attaching the weight to the sample.
Pin Chamber Caliper Measurement Device	Constructed according to Figure 14.

Procedure

The undergarment is draped over the test apparatus 100 with the front of the waist opening directed toward the front portion of the test apparatus 100C. Insure that the support legs 106 are in the leg openings of the undergarment. The waistband is pulled over the front portion 100C and the rear portion 100D. Reposition the undergarment on the test apparatus 100 to insure it is centered thereon, insuring that the front edge of the crotch portion of the undergarment is in front of the front end edge of the curved pieces 120A (see 15 and 16). A properly disposed undergarment is shown in Figure 18.

Weights 124 are hung from the clamp 118 at the end of the sample at the rear portion of the test apparatus. The weight is gently hung from the rear waist band of the sample undergarment by clamping clamp 118 thereto as it is laid over the waist edge of the test

apparatus. The weight should not be dropped, nor should a sudden force be applied with the weight when the pad is hanging freely.

The weight on the end of the sample at the rear portion of the test device places a stretching force on the sample so that the sample tends to want to form a straight path between the clamps. At this point, the sample will move into as close contact within the slit as the sample is capable of achieving under the test conditions. Remove the weight after five seconds.

The test apparatus 100 is turned right side up so that it rests on its support legs 106. The Pin Chamber caliper measurement device is then used to measure the distance the sample rises within the slit from the outside surface 100B of the arcuate plates (the baseline).

The Pin Chamber 128 comprises a case with a plurality of narrow (1.1 mm diameter), spaced apart, vertically-oriented, lightweight (28.4 mg) pins 146 arranged in a row across the device. The pins are movable in the vertical direction. The Pin Chamber case has a glass window in the front and back so that the height of the pins can be observed when the Pin Chamber is in use. A ruler 148 marked in millimeter increments is provided along side of the pins prior to the placement of the sample on the test apparatus. The Pin Chamber is positioned over the test apparatus so that it straddles the test apparatus. A measurement to determine the distance the pins drop to the bottom surface of the arcuate plates is taken at each of the desired locations. These measurements serve as the baseline values for the test. The distance the pins drop above or below the baseline is then measured by gently lowering the pins with the sample in place. It should be noted that the slit is wide enough that several pins may drop between the edges of the slit at various locations. If that occurs, the reading taken is that of the highest pin.

The first measurement is taken at a point that is spaced 47 mm forward of the transverse centerline R of the test apparatus. This distance is intended to correspond with the labia area of wearer's body. (This 47 mm distance, and the following two distance measurements are measured along the curvature of the inside surface 100A of the test apparatus.) The second measurement is taken at a point that is spaced 17 mm to the rear of the transverse centerline of the test apparatus. This is intended to correspond with the wearer's perineum. The third measurement is taken at a point that is spaced 70 mm to the rear of the transverse centerline of the test apparatus. This is intended to correspond with the wearer's "gluteal groove". These values are recorded. The foregoing procedure is

repeated for at least two representative samples. The measurements obtained are then averaged to provide a value for the Lift of the sample at each of the locations.

Stretch Modulus and Elastic Contractions

Intent

This method is intended to quantify a force comparable to the force exerted on a wearer's body by extensible materials that may be used in an undergarment over an extension range similar to that seen in the wear cycle of an undergarment.

Method

The method described in INDA (Association of Nonwoven Fabric Industry) Standard Test 110.1-92 is suitable. The following set up conditions are used:

Gage Length:	2 inches (5.08 centimeters)
Crosshead Speed:	10 inches/minute (25.4 centimeters/minute)
Tensile Testing Machine: and Load Cell	Appropriate for expected force range, a Model 5564, available from Instron Corporation, Canton, MA is suitable
Sample Width:	1 inch (2.54 centimeters) For samples less than 1 inch (2.54 centimeters) wide, measure the sample width and adjust the measured force by the ratio of 1 inch (2.54 centimeters) to the measured width.
Sample Direction:	Longitudinal stretch modulus samples are cut so the sample width is perpendicular to the longitudinal direction. Lateral stretch modulus samples are cut so the sample width is perpendicular to the lateral direction.
Sample Size:	At least three samples per material tested

Calculations

$Force_0$:	Force at start of data collection (grams/inch or grams/centimeter)
$Force_{25}$:	Force at 25% elongation (grams/inch or grams/centimeter)

Elastic Contractions = $Force_{25}$

Stretch Modulus = $(Force_{25} - Force_0)/0.25$

Report the mean and standard deviation for elastic contractions (leg elastics only) and for stretch modulus

Body Contact Force

Introduction

This test is intended to determine the force exerted on a wearer's body by an elasticized undergarment. A commercially available mannequin is used to minimize error due to body dimension variation.

Apparatus

Mannequin	Suitable is a female, anatomically correct mannequin as is used to train medical personnel in catherization techniques. The mannequin has the following dimensions: thigh circumference—54 cm, waist circumference—92 cm, hip circumference—95 cm, andfront waist to back waist through groin—59 cm and is available from NASCO of Ft. Atkinson, WI as catalog number LF 856.
Pressure Sensors	Ultra thin pizeo resistive pressure sensors (5mm X 15mm, 0-10 mm Hg pressure range, with biomedical lead wires) as are available from Vistamedical, Ltd. of Winnipeg, Manitoba, Canada.
Computer	Pentium® based computer with 8MB RAM using the Windows 95® operating system. A laptop computer as is available from Dell Computer Corp. of Austin, TX as a model Latitude LM is suitable.
Electronic Interface Module	Model FSA-C-2-1.00 as is available from Vistamedical, Ltd. of Winnipeg, Manitoba, Canada.
Data Acquisition Software	FSA Version 3.1 as is available from Vistamedical, Ltd. of Winnipeg, Manitoba, Canada.

Method

1. Attach the leads from each sensor to the interface module according to the manufacturer's instructions. Calibrate each sensor by placing the sensor on an

inflated air bladder (7.5 g/cm^2) and subjecting the sensor to known pressures (up to 7.5 g/cm^2) provided by a second air bladder that is disposed on the first bladder, the bladders being confined within a containment box as is supplied by the manufacturer. The FSA software acquires the signal produced and compares the signal with the calibration pressure which is entered by the operator. This comparison is used to build a calibration table which is stored as a file in the computer.

2. Attach the sensors to the mannequin 400 (Figures 19A, 19B, 20A, and 20B) using double sided transfer tape (available from 3M of St. Paul, MN as part no. 950). A first pair of sensors 410, 415 is placed on the apex of the manniquen's labia minora centered on the mannequin's urethra. A second pair of sensors 420, 425 is placed on the apex of the manniquen's labia majora at a position 6 mm anterior to sensors 410, 415 (Figures 19A, 19B). A third pair of sensors 430, 435 is placed on the surface of the manniquen's gluteaus at a position 32 mm posterior to the manniquen's posterior commissure of the labia minora (Figures 19A and 19B). The fourth and last set of sensors 440, 445 is placed on the surface of the manniquen's mons at a position 65 mm anterior to the center of the mannequin's urethra (Figures 20A and 20B).

3. Pull the garment on to the mannequin so it is smooth and symmetrically disposed about the manniquen's coronal centerline. The garment should be drawn up so as to be moderately tight. Reproducibility can be improved by recording the pressures at sensors 430, 435, 440, and 445 for a first garment and positioning subsequent garments so as to have as close to the same pressure as possible.

4. Acquire force data from sensors 410, 415, 420, and 425 using the interface module and software according to the manufacturer's instructions. A minimum of 4 samples should be evaluated. If desired, the acquired data can be exported into a spreadsheet file for further analysis by following instructions provided with the software.

5. Report mean and standard deviation for each sample. When samples are being compared, known statistical techniques (e.g. Analysis of Variance) can be used.

The disclosures of all patents, patent applications (and any patents which issue thereon, as well as any corresponding published foreign patent applications), and publications mentioned throughout this description are hereby incorporated by reference

herein. It is expressly not admitted, however, that any of the documents incorporated by reference herein teach or disclose the present invention.

It should also be understood that all of the limits and ranges specified herein include all narrower ranges, limits, and amounts that are within the specified limits and ranges and that such narrower ranges and limits may be claimed even though those limits and ranges are not separately listed.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

WHAT IS CLAIMED IS:

1. A system of a disposable absorbent article and a garment for holding said disposable absorbent article, said system characterized in that said garment is capable of holding said absorbent article in close bodily contact, said system comprising:

a disposable absorbent article comprising a liquid pervious side, a liquid impervious side opposite said liquid pervious side, and an absorbent component between said liquid pervious side and said liquid impervious side, wherein said liquid pervious side and said liquid impervious side are arranged to form a unitary structure, and said disposable absorbent article is capable of maintaining contact with and covering at least a portion of the inside surfaces of the wearer's labia, and at least a portion of the exterior surfaces of the wearer's labia; and

a garment for wearing around a wearer's waist for holding said disposable absorbent article in close bodily contact, said garment having a waist opening, a pair of leg openings, and a longitudinal centerline, said garment comprising a crotch region that is capable of holding said disposable absorbent article in close contact with the wearer's pudendal region, wherein said disposable absorbent article is capable of covering at least a portion of said crotch region of said garment.

2. The system of Claim 1 wherein said disposable absorbent article is of a size and configuration to cover a female wearer's pudendal region and perineum, and does not extend substantially forward beyond the wearer's mons pubis or rearward to the wearer's anus.

3. The system of Claims 1 or 2 wherein said disposable absorbent article maintains substantially sustained contact with, and covers at least a portion of the inside surfaces of the wearer's labia, at least a portion of the exterior surfaces of the wearer's labia, and at least a portion of the crotch region of said garment in use.

4. A system according to any of the preceding claims wherein said disposable absorbent article covers substantially all of the interior surfaces of the wearer's labia up to and including the floor of the wearer's vestibule.

5. A system according to any of the preceding claims wherein said disposable absorbent article covers substantially all of the exterior surfaces of the wearer's labia.

6. A system according to any of the preceding claims wherein the crotch region of said garment assumes a configuration that generally conforms to the shape of the wearer's pudendal region in use when the wearer's legs are together.

7. A system according to any of the preceding claims wherein the crotch region of said garment assumes a configuration that generally conforms to the shape of the wearer's pudendal region in use when the wearer's legs are apart.

8. A system according to any of the preceding claims wherein the crotch region of said garment assumes a modified cusp-shaped configuration when worn, wherein the cusp-shaped configuration is modified in that said crotch region assumes a rounded convex upward shape in the longitudinally-oriented area centered about the space between the wearer's labia which lies between two convex downward curved portions of said crotch region.

9. A system according to any of the preceding claims wherein said disposable absorbent article is sufficiently flexible in at least several regions thereof so that said disposable absorbent article assumes a configuration similar to the crotch region of said garment.

10. A system according to any of the preceding claims wherein said absorbent article has a longitudinal central region that is capable of being positioned in the space between the wearer's labia, said longitudinal central region being capable of residing in said space between the wearer's labia at an elevation that is higher than at least some portions of the absorbent article that are located laterally outboard of said longitudinal central region.

11. A system according to Claim 10 wherein said absorbent article is capable of assuming such a configuration without compression by the inner portion of a wearer's thighs.

12. A system according to Claim 11 wherein said absorbent article is generally planar prior to use.

13. A system according to Claim 11 wherein said absorbent article has a body-facing side with a raised portion thereon.

14. The system of Claim 13 wherein said raised portion comprises a tube of absorbent material joined to said liquid pervious side of said absorbent article.

15. The system of Claim 13 wherein said raised portion comprises a hump-forming element, and said liquid pervious side comprises a liquid pervious topsheet, wherein said hump-forming element underlies said liquid pervious topsheet.

16. A system according to any of the preceding claims wherein said absorbent article has a longitudinal central region that is capable of being positioned in the space between the wearer's labia, and portions of said absorbent article outside said longitudinal central region are capable of cupping the wearer's labia from the front of the labia to the back of the labia.

17. A system according to any of the preceding claims wherein the absorbent article is less than or equal to 7 inches (18 cm) in length.

18. A system according to any of the preceding claims wherein both said absorbent article and the crotch region of said garment are vapor permeable.

19. A system of a disposable absorbent article and a garment for holding said disposable absorbent article in close bodily contact, said system comprising:

a disposable absorbent article comprising a liquid pervious side, a liquid impervious side opposite said liquid pervious side, and an absorbent component between said liquid pervious side and said liquid impervious side, wherein said liquid pervious side and said liquid impervious side are arranged to form a unitary structure, and said disposable absorbent article is of a size and configuration to cover a female wearer's pudendal region, perineum, and immediately adjacent regions, and does not extend substantially forward beyond the wearer's mons pubis or rearward to the wearer's anus; and

a garment for wearing around a wearer's waist for holding said disposable absorbent article in close bodily contact, said garment having a waist opening, a pair of leg openings, and a longitudinal centerline, said garment comprising a crotch region that is capable of holding said disposable absorbent article in close contact with the wearer's pudendal region,

wherein a portion of the absorbent article overlies the longitudinal centerline of the supporting garment, and portions of the absorbent article overlie portions of the crotch region of the supporting garment that are located laterally outboard of the longitudinal centerline of the supporting garment, and the crotch region of the supporting garment provides a body contact force along its longitudinal centerline

which is sufficient to lift the portion of said absorbent article that overlies the same to an elevation that is higher than at least some portions of the absorbent article that overlie those portions of said crotch region that are located laterally outboard of said longitudinal centerline.

20. The system of Claim 19 wherein at least some of the portions of said absorbent article that are capable of maintaining contact with and covering at least a portion of the exterior surfaces of the wearer's labia, will flex under body-contacting pressures of less than or equal to 20 g/cm^2.

21. The system of Claim 19 wherein the crotch region of said supporting garment has edges the form part of said leg openings, and said edges of said crotch region apply a body contacting pressure to the wearer's body of less than or equal to 20 g/cm^2.

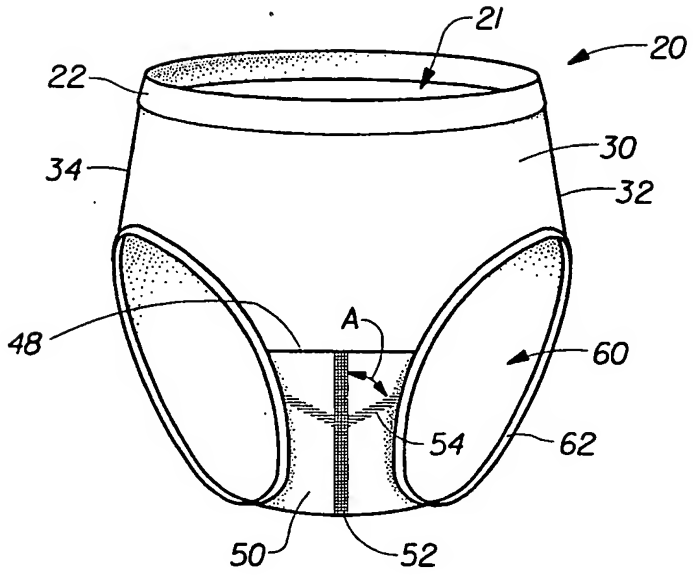


Fig. 1

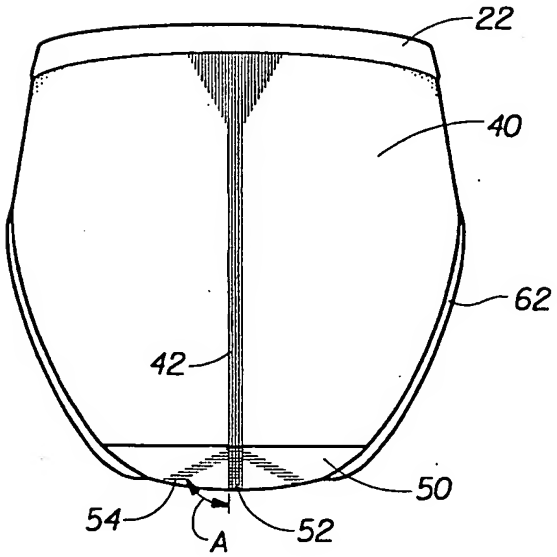


Fig. 2

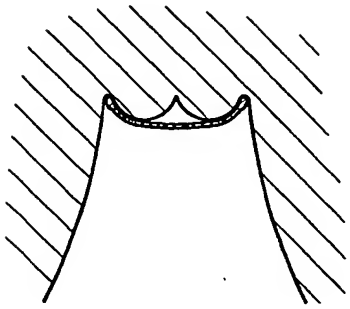


Fig. 3
Prior Art

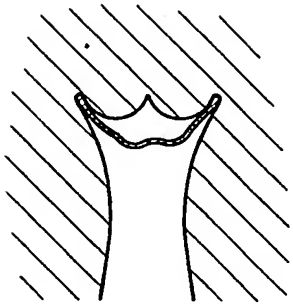


Fig. 4
Prior Art

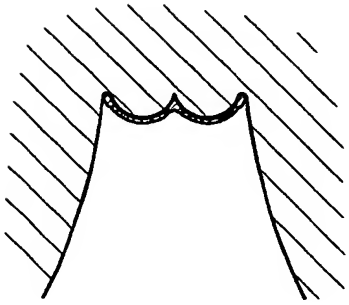


Fig. 5

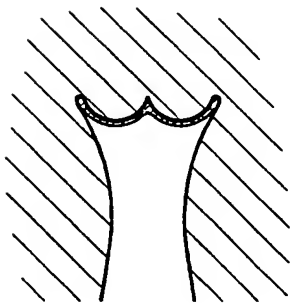


Fig. 6

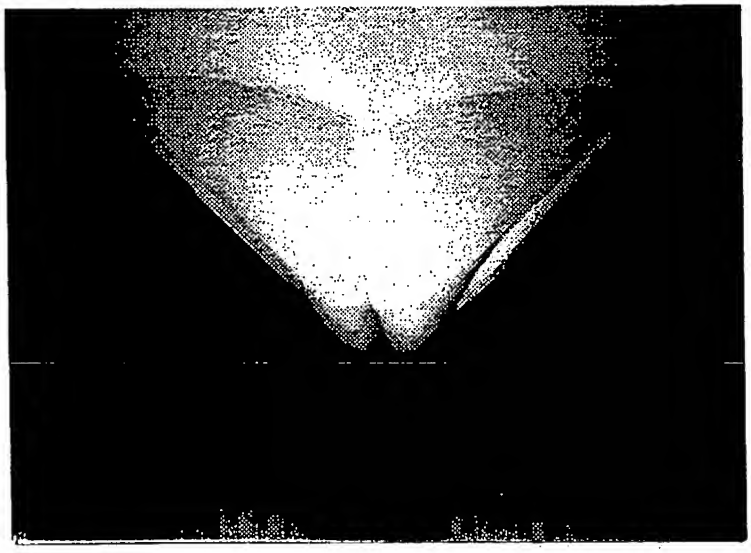


Fig. 7

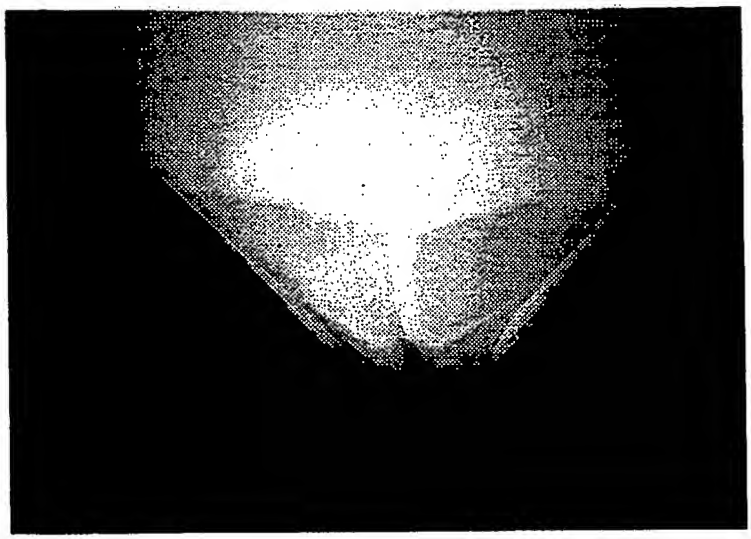


Fig. 8

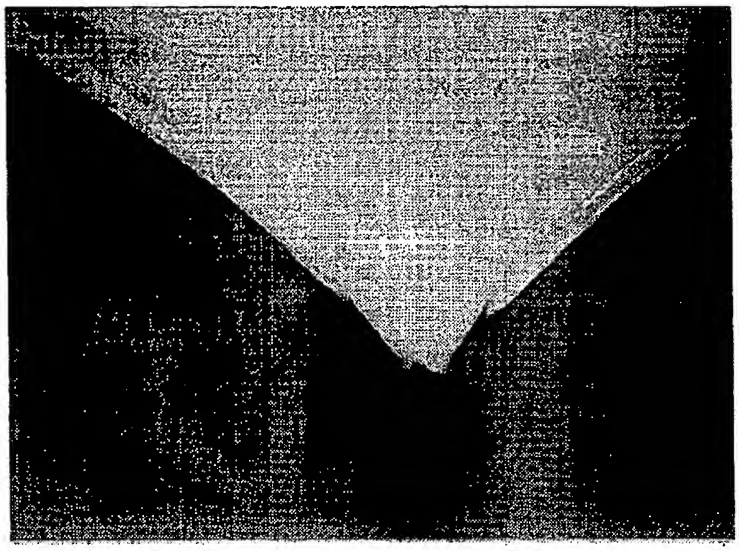


Fig. 9
Prior Art

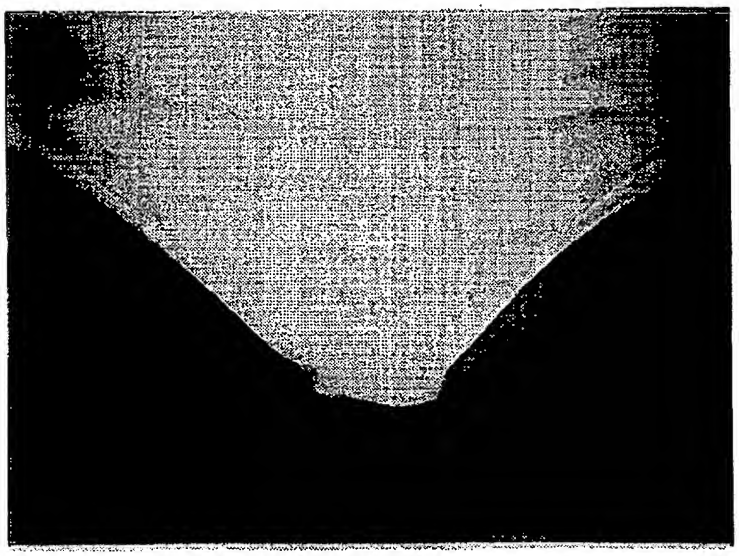
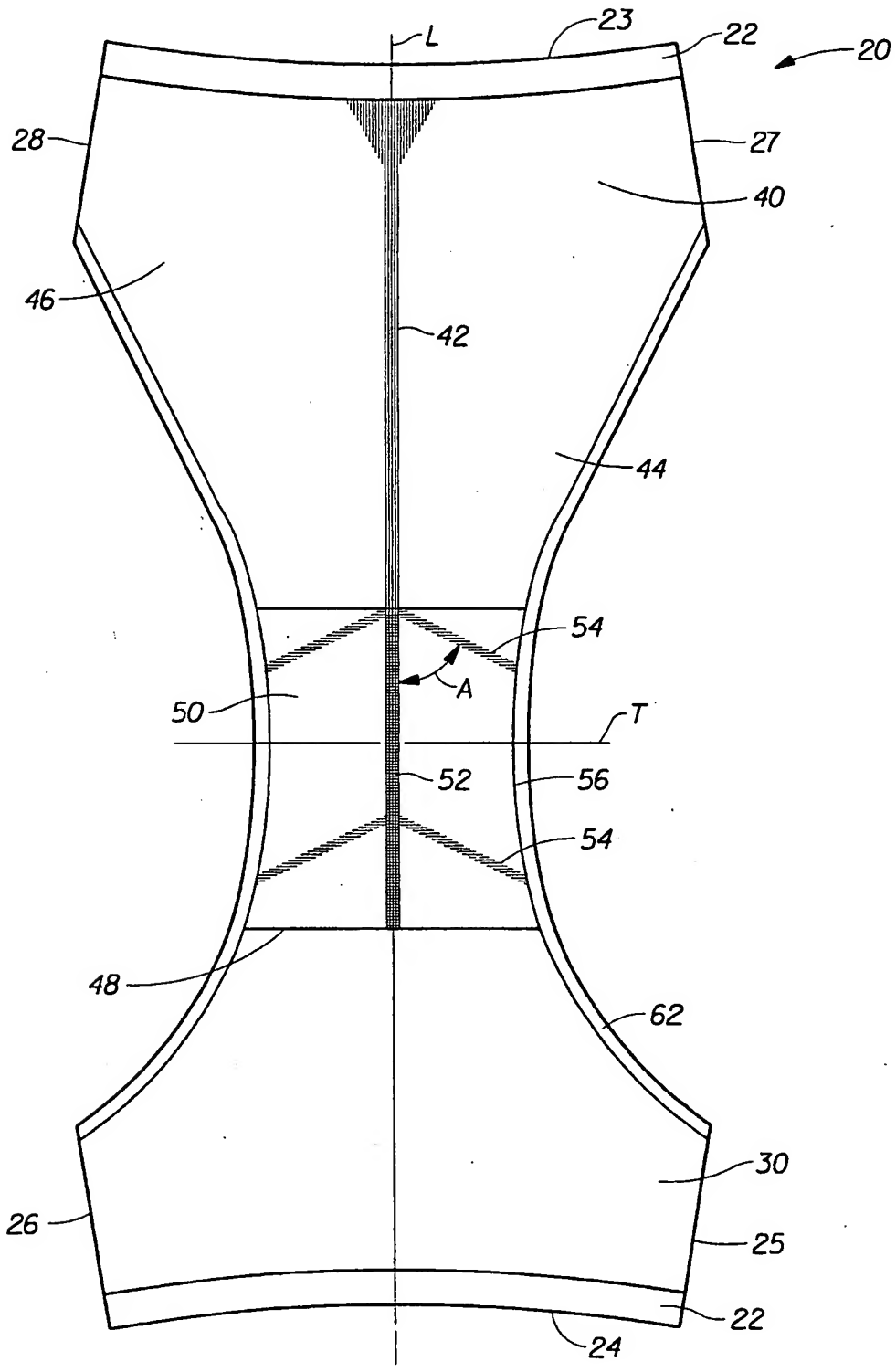


Fig. 10
Prior Art



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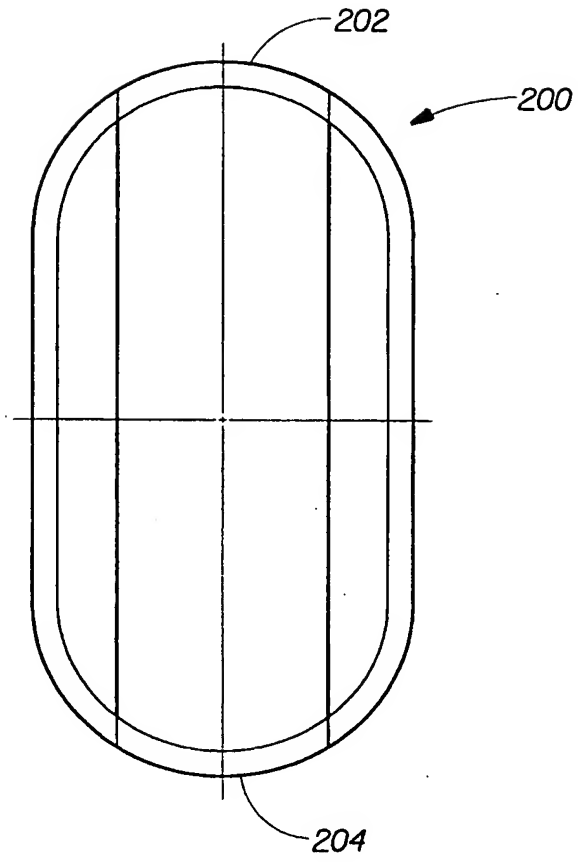

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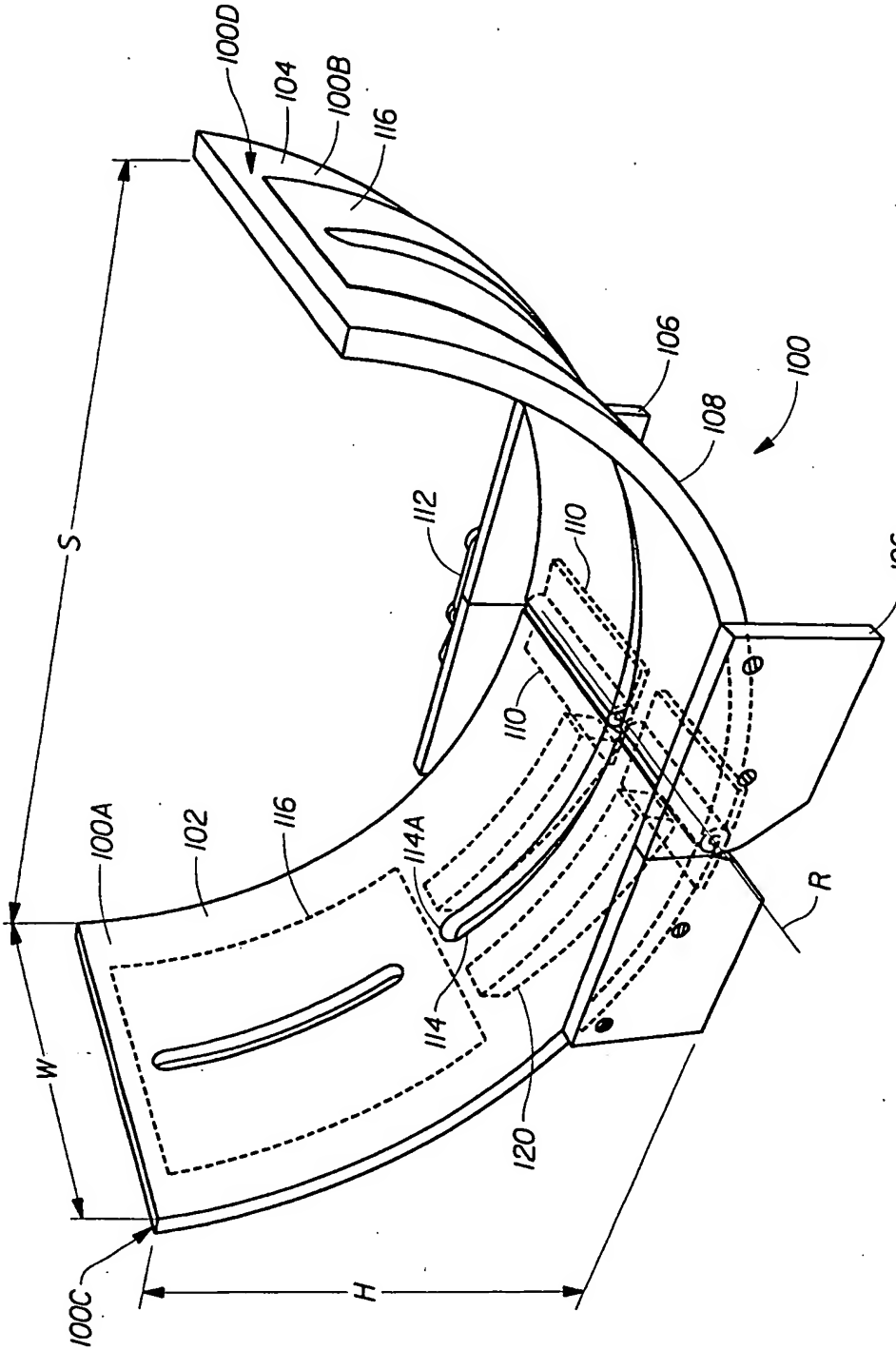
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Fig. 13

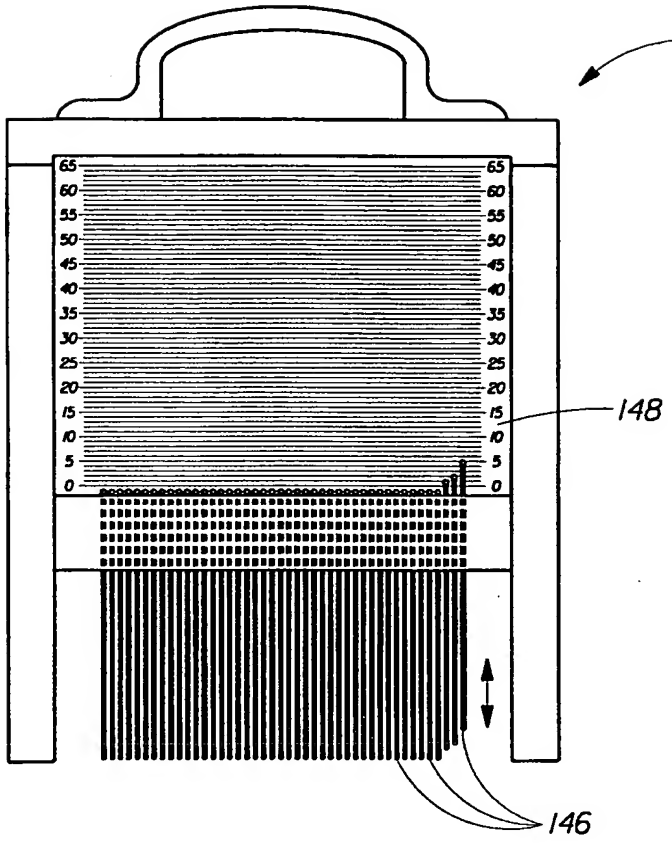

Fig. 14

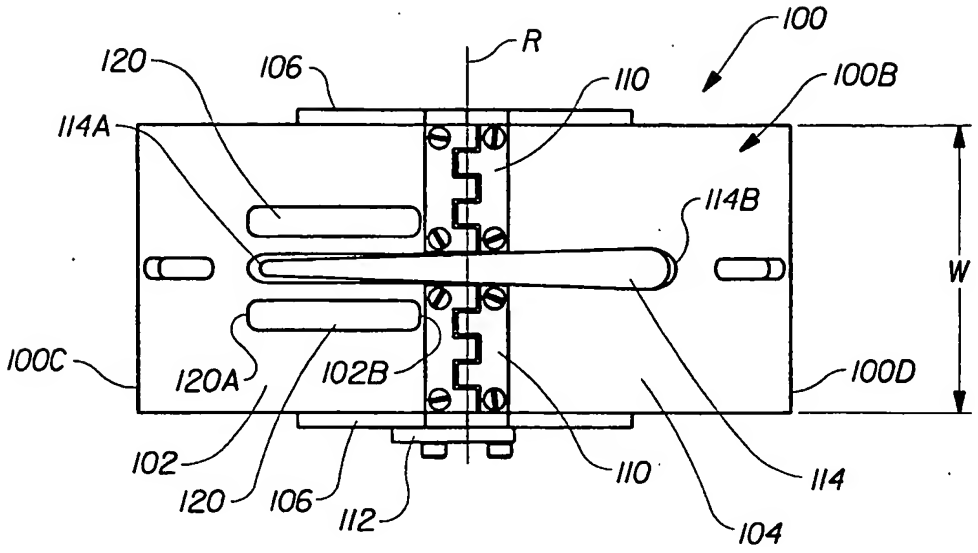
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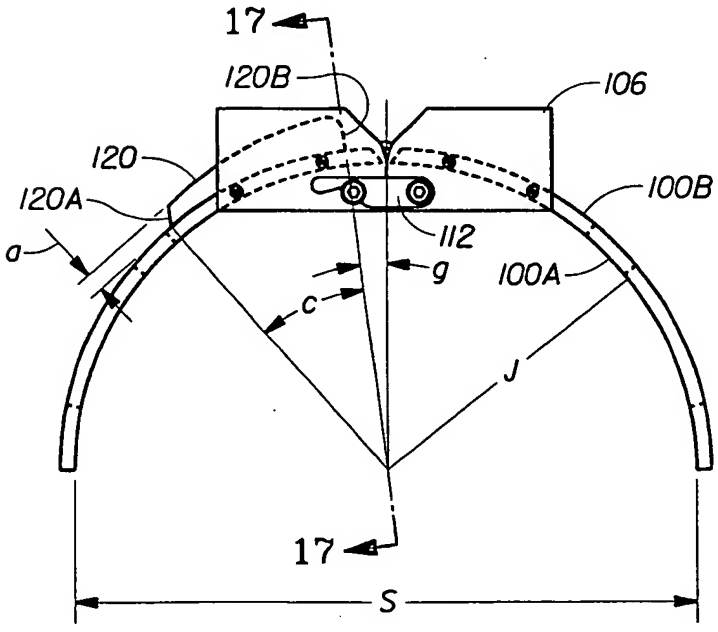
Fig. 15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c
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Fig. 16

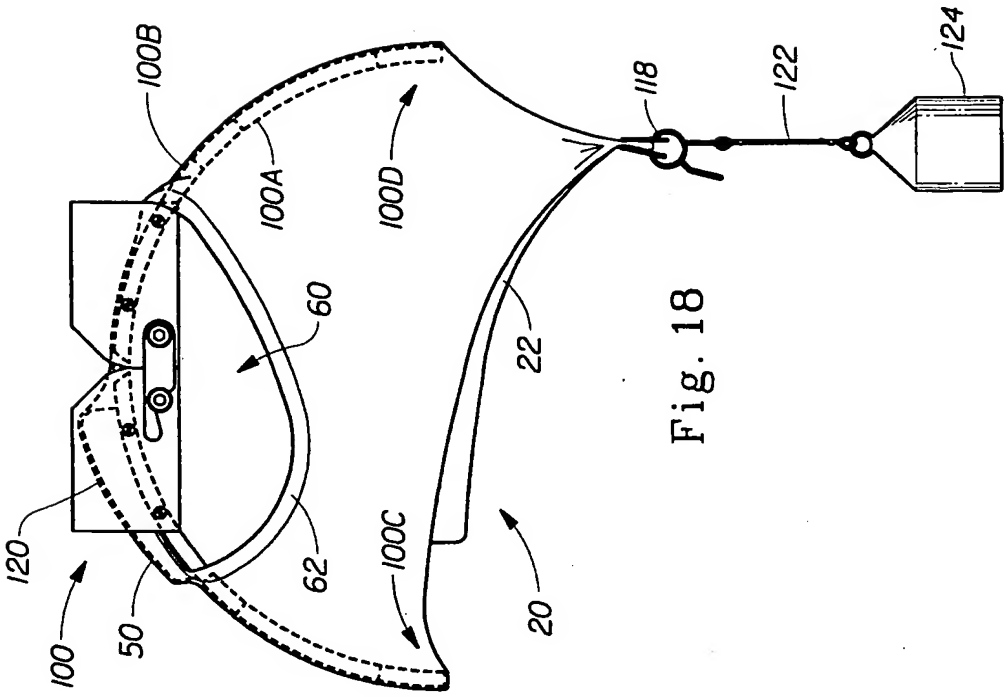
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Fig. 18

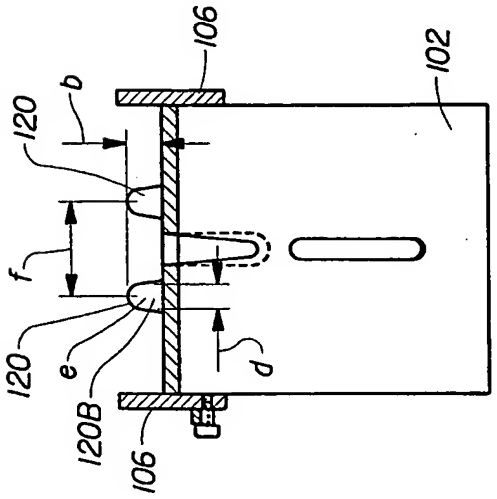
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Fig. 17

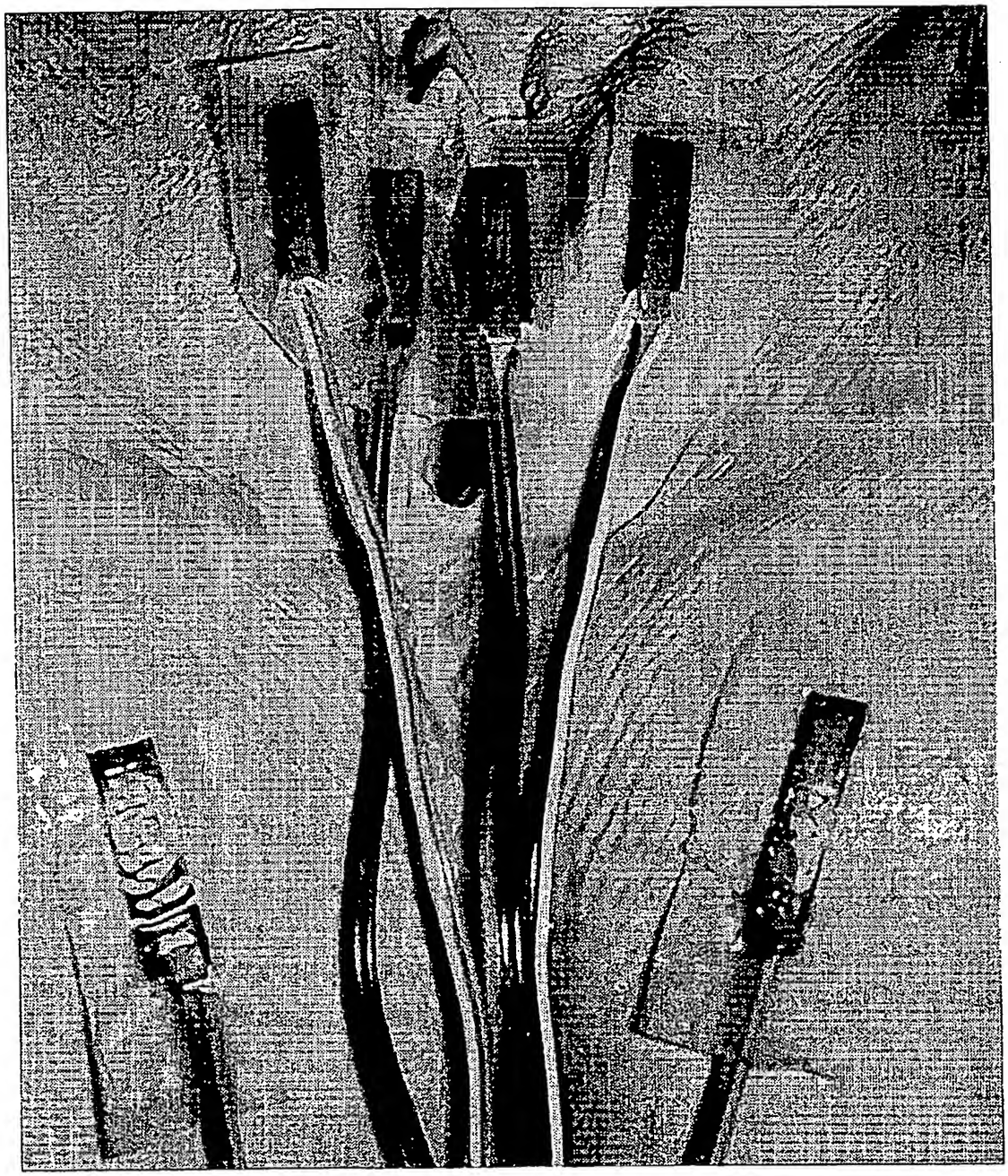

Fig. 19A

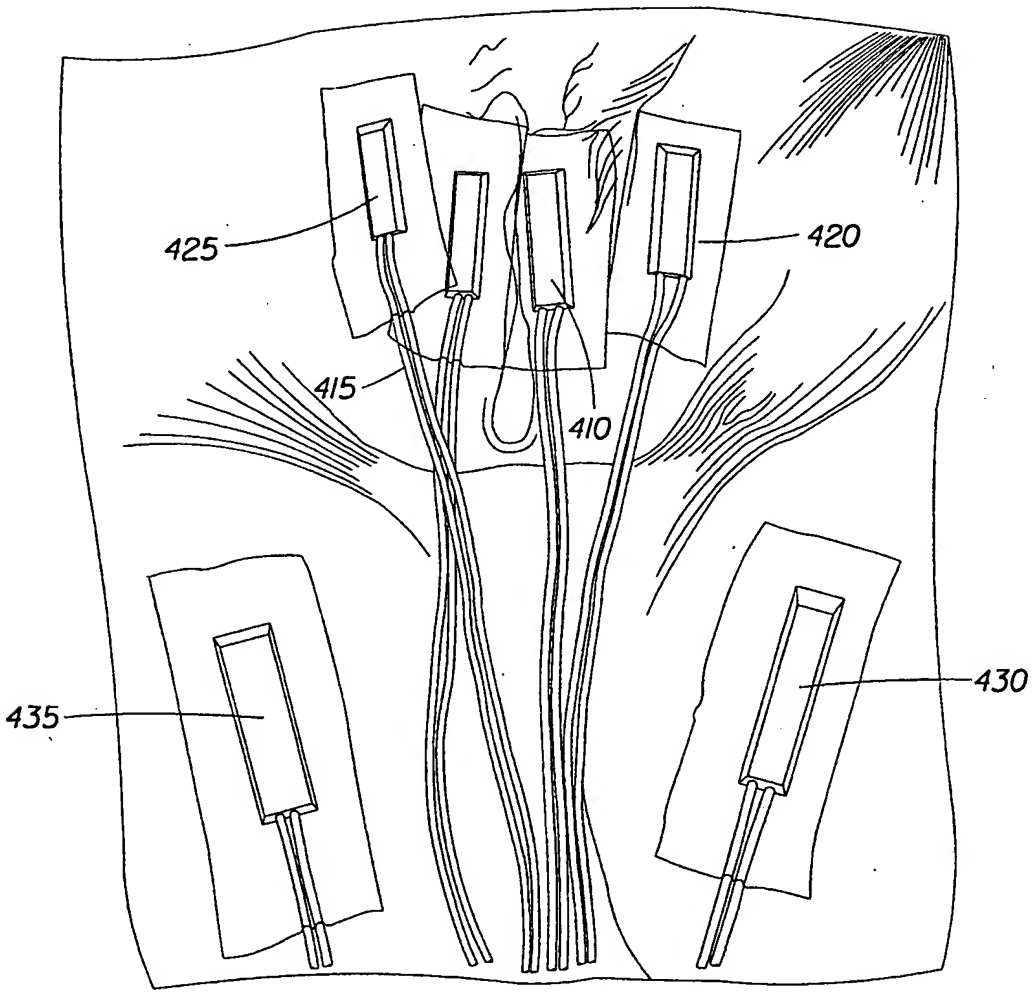

Fig. 19B

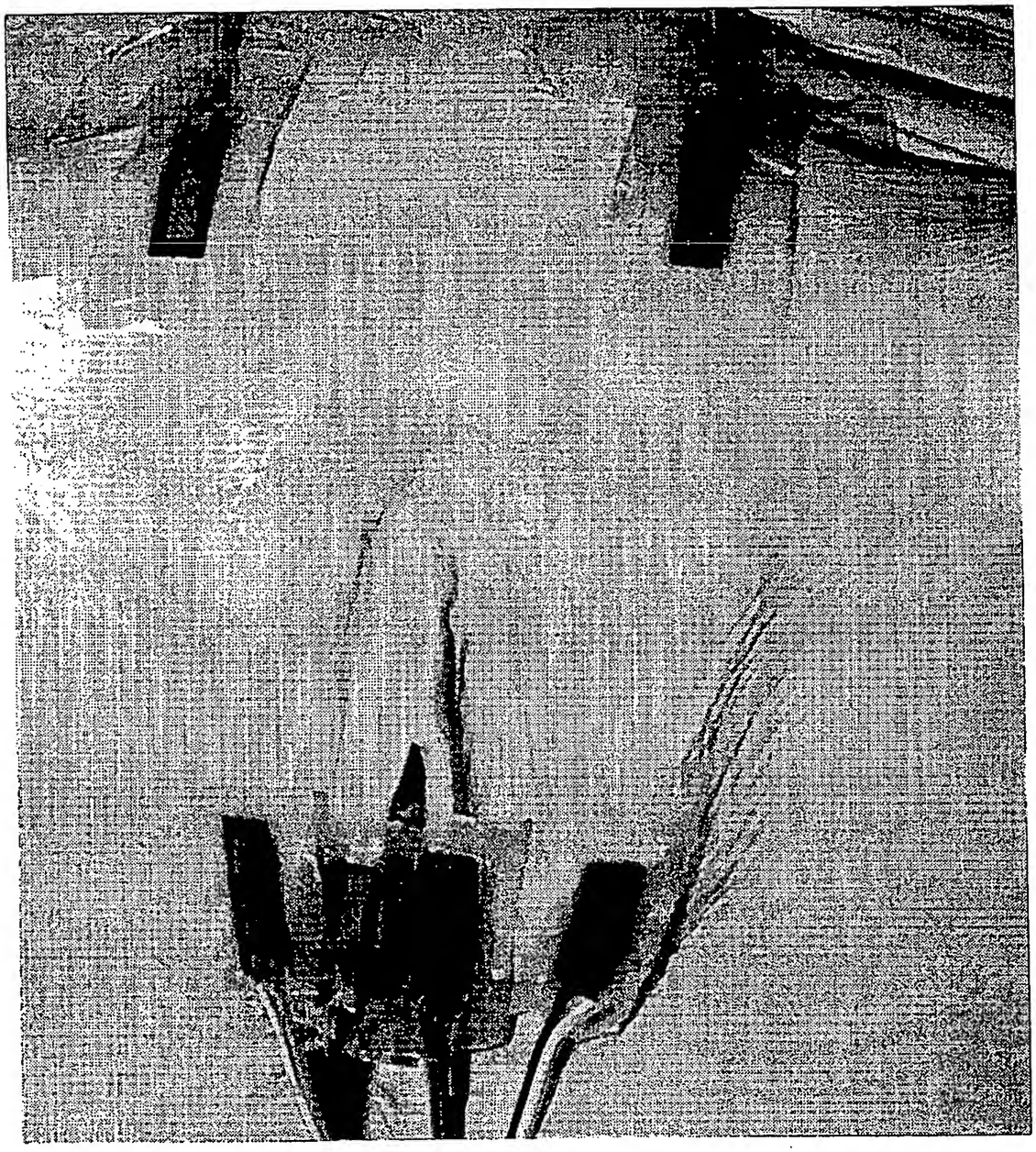

Fig. 20A

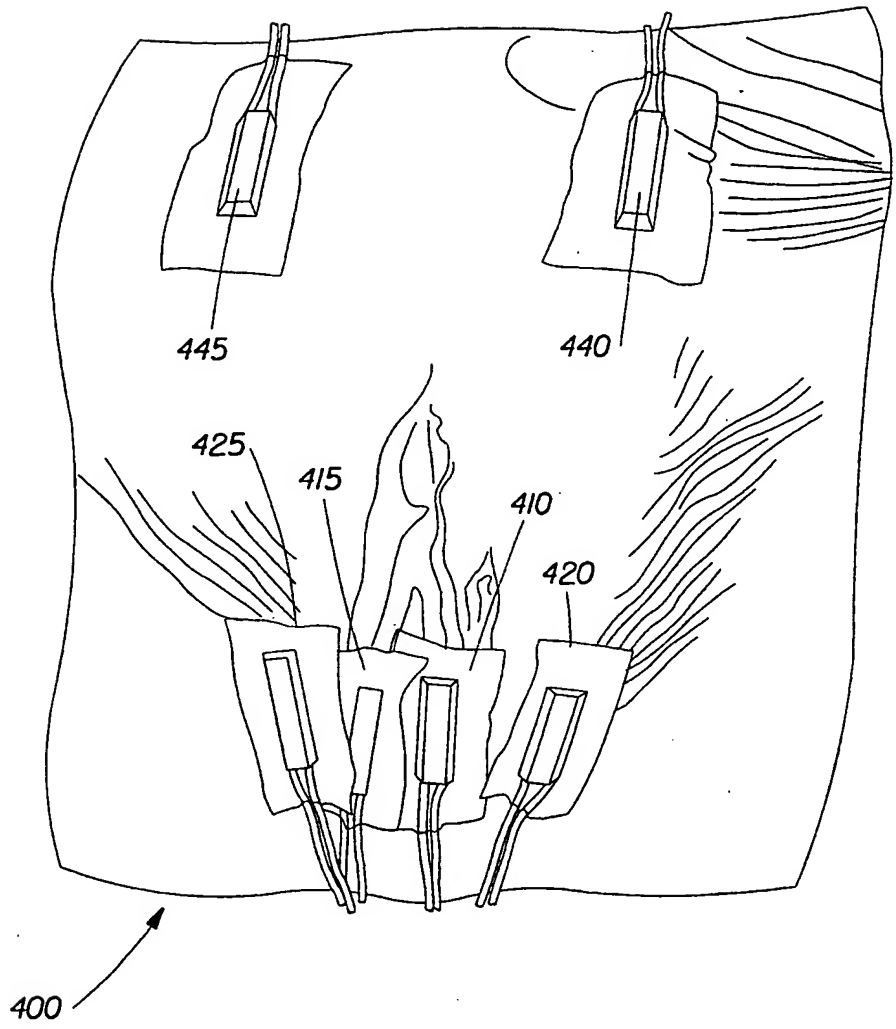

Fig. 20B

INTERNATIONAL SEARCH REPORT

:national Application No
PCT/US 98/23757

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61F13/15 A61F13/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61F A41B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A,P	WO 98 33463 A (MOELNLYCKE AB ;WIDLUND URBAN (SE)) 6 August 1998 see figures 3-6 see page 12, line 26 - page 13, line 36 see page 14, line 11 - line 21 see page 18, line 4 - page 19, line 29 --- -/--	1,3-10, 16,19

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 March 1999	19/03/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mary, C

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

national Application No
PCT/US 98/23757

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 672 165 A (BELECKY JUNE MARIAN ET AL) 30 September 1997 see figures 1-3 see column 3, line 66 - column 4, line 12 see column 5, line 20 - line 37	1,3,4,6, 7,9,10, 16
A	EP 0 597 498 A (KIMBERLY CLARK CO) 18 May 1994 see figures 1-5 see column 3, line 49 - column 4, line 24 see column 5, line 23 - column 6, line 10 see column 6, line 16 - line 56	1-7,9, 10,16, 17,19
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Information on patent family members

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